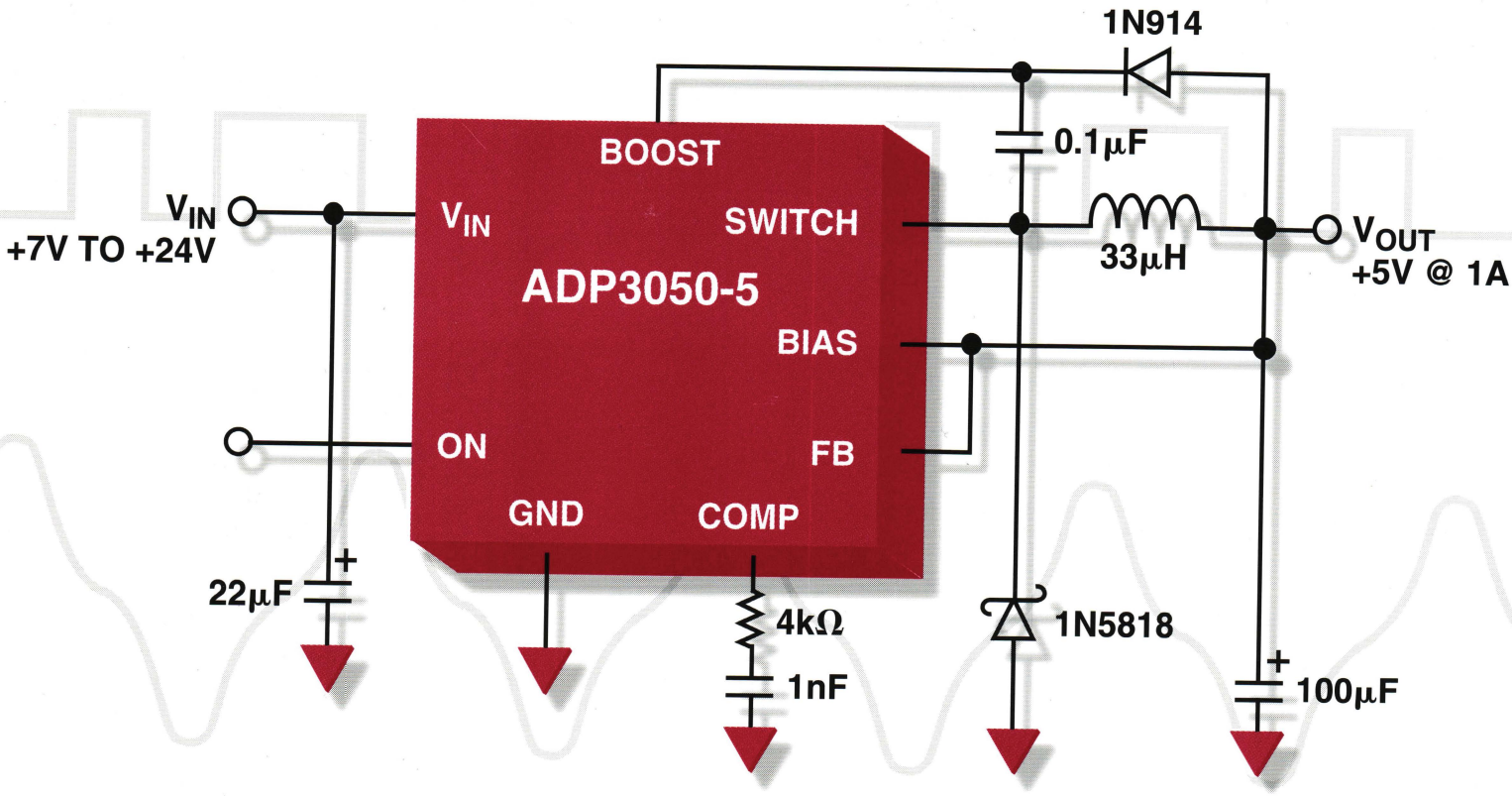
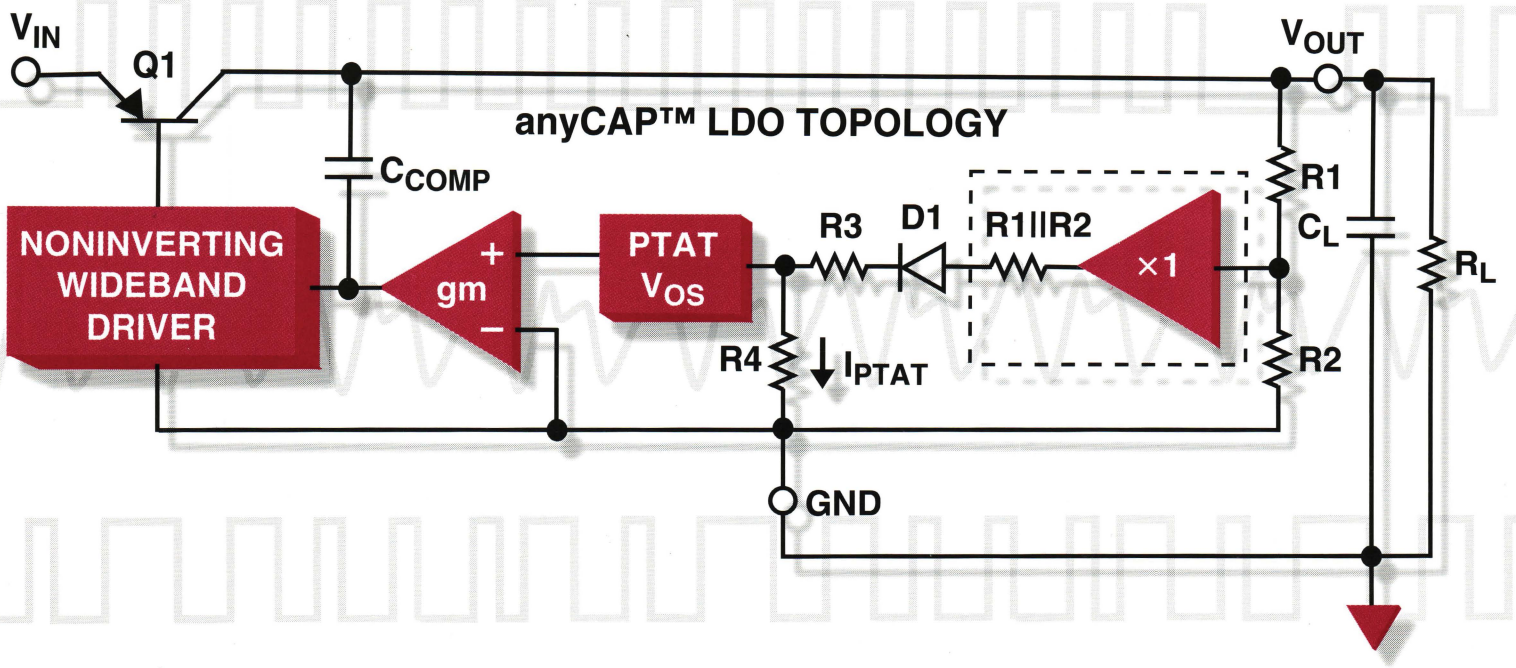
POWER AND THERMAL MANAGEMENT COMPONENTS SELECTION GUIDE





POWER/THERMAL COMPONENTS – SELECTION GUIDE

ANALOG DEVICES

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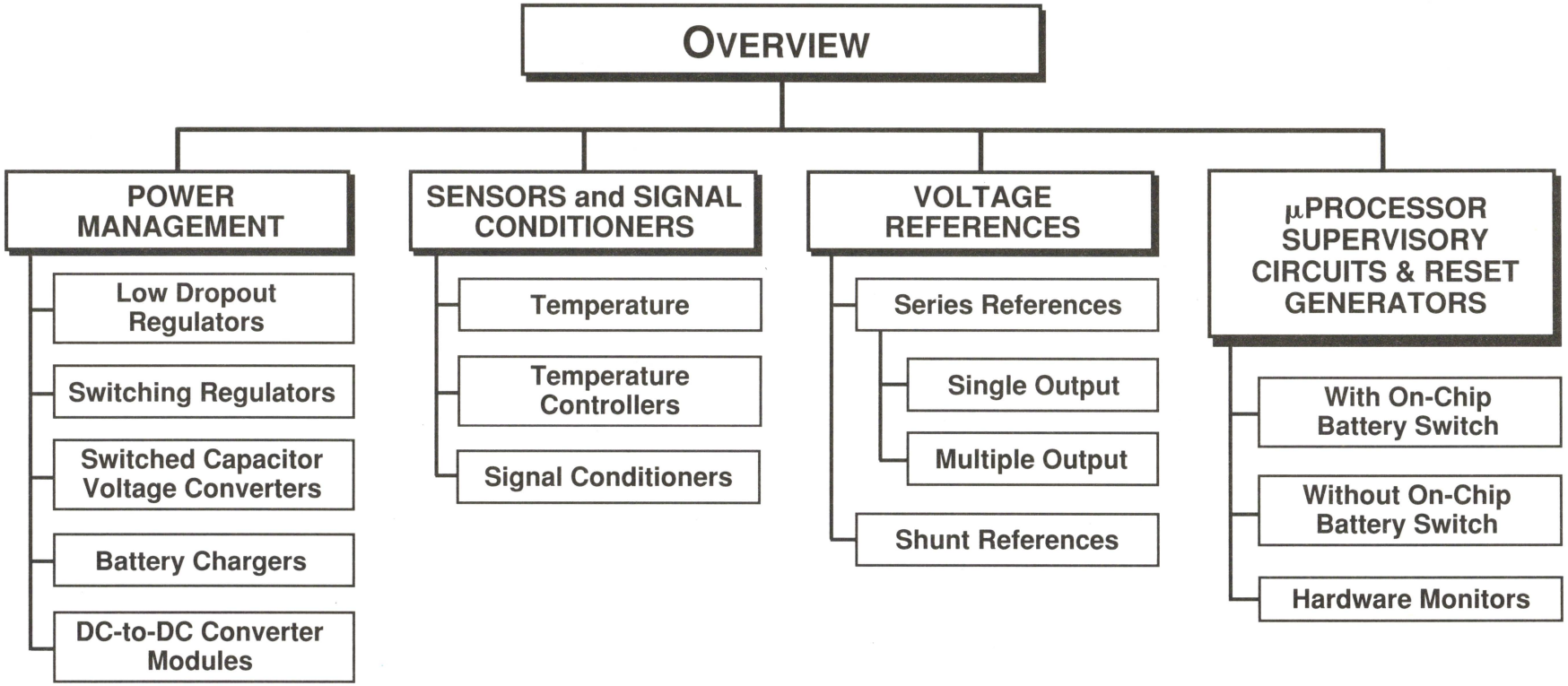
ANALOG DEVICES' POWER MANAGEMENT PRODUCTS FAXCODE LIST

Model Number	Description	Fax-code
AD580	+2.5 V, 3-Terminal Series Regulator, V_{OS} = 10 > 75 mV, TCV_{OS} = 10 > 85 ppm, Bandgap	1176
AD584	Multitap, +2.5,+5, +7.5, +10 V, Bandgap	1180
AD586	+5 V, V_{OS} = 2 > 25 mV, TCV_{OS} = 2 > 25 ppm, Buried Zener	1182
AD587	+10 V, V_{OS} = 5 > 10 mV, TCV_{OS} = 5 > 20 ppm, Buried Zener	1183
AD588	Pin Programmable, +10, +5, ±5, –5, –10 V, Buried Zener	1184
AD589	+1.2 V, V_{OS} = 15 mV, TCV_{OS} = 10 > 100 ppm, I_Q = 50 µA, Bandgap	1185
AD590	Temperature Sensor, Current Output I = 1 µA/Degree Kelvin	1186
AD592	Temperature Sensor, Current Output I = 1 µA/Degree Kelvin	1187
AD594/AD595	Amplifier, J/K Type Thermocouples	1188
AD596/AD597	Amplifier, J/K Type Thermocouples, Setpoint Controller	1190
AD680	+2.5 V, IQ = 250 µA, V_{OS} = 50 > 100 mV, TCV_{OS} = 25 > 50 ppm	1231
AD688	±10 V, V_{OS} = 2 > 5 mV, TCV_{OS} = 3 > 6 ppm, e_N = 6 µV p-p, Buried Zener	1234
AD780	+2.5 V or +3.0 V Pin Strappable, V_{OS} = 1 > 5 mV, TCV_{OS} = 7 to 20 ppm, Low Noise	1355
AD1580	+1.2 V, E_{OS} = 10 mV, TCV_{OS} = 50 > 100 ppm/°C	1963
AD1582	+2.5 V, 1/0.1% Accuracy 50/100 ppm, 3-Terminal, I_Q = 50 µA, Bandgap, Source/Sink 5 mA	2125
AD1583	+3.0 V, 1/0.1% Accuracy 50/100 ppm, 3-Terminal, I_Q = 50 µA, Bandgap, Source/Sink 5 mA	2125
AD1584	+4.096 V, 1/0.1/% Accuracy 50/100 ppm, 3-Terminal, I_Q = 50 µA, Bandgap, Source/Sink 5 mA	2125
AD1585	+5.0 V, 1/0.1/% Accuracy 50/100 ppm, 3-Terminal, I_Q = 50 µA, Bandgap, Source/Sink 5 mA	2125
AD7416	10-Bit, +3 V or +5 V @ 1.5 mA, 0.1 MSPS, I^2C Serial I/O, Auto Power-Down, INT V_{REF} = 2.5 V, LM75 Pinout	2209
AD7816	10 Bit, +3 V or +5 V @ 1.5 mA, 0.1 MSPS, SPI Serial I/O, Auto Power-Down, INT V_{REF} = 2.5 V, Over Temp Regr, 8 Pins	2091
AD22100	Temp Sensor with Signal Conditioning, Output Is Ratiometric to V_{CC}, –50 to 150°C, 22.5 mV/°C	1091
AD22103	Temp Sensor with Signal Conditioning, Output Is Ratiometric to V_{CC}, 0 to 100°C, 28 mV/°C	1861
AD22105	Temp Range –40 to +125°C, Resistor Prgm., V_S = +2.7 to +7 V, I_Q = 75 µA, Output = Open Collector @ 1 mA	1974
ADDC02803	18 to 28 V Input, +3 V Output at 20 Amps, Integral EMI Filters	1947
ADDC02805	18 to 28 V Input, +5 V Output at 20 Amps, Integral EMI Filters	1947
ADDC02808	18 to 28 V Input, Pulsed +8 V Output at 25 Amps, Integral EMI Filters	2071
ADDC02812	18 to 28 V Input, ±12 V Output at 8.33 Amps, Integral EMI Filters	2012
ADDC02815	18 to 28 V Input, ±15 V Output at 8.33 Amps, Integral EMI Filters	2012
ADDC02828	18 to 28 V Input, +28 V or –28 V Output at 3.6 Amps, Integral EMI Filters	2101
ADDC27005	160 to 400 V Input, +270 V Nominal Input, +5 V Output at 20 Amps, Integral EMI Filters	2099
ADDC27008	160 to 400 V Input, +270 V Nominal Input, +8 V Output at 6.66 Amps, Integral EMI Filters	2100
ADM1232	V_{CC} Monitor, Watchdog Timer 140 > 1200 msec, Manual Reset,/RST & RST Outputs, DS1232 & DS1232LP 2nd Source	2182
ADM660	Inverter or Voltage Doubler, V_{IN} = +2.5 V > +7 V, V_{OUT} = +5 to +14 V, or V_{IN} = +1.2 > +7 V, V_{OUT} = –1.2 > –7 V	1934
ADM663	Dual Mode, V_{IN} = +2 to +16.5 V, V_{OUT} = +5 V or Adjustable +1.3 to +16 V, I_Q = 12 µA, I_{OUT} = 40 mA	1558
ADM663A	Tri-Mode, V_{IN} = +2 to +16.5 V, V_{OUT} = +3.3 V, +5 V, or Adj. +1.3 to +16 V, I_Q = 9 µA, I_{OUT} = 100 mA	1559
ADM666	Dual Mode, V_{IN} = +2 to +16.5 V, V_{OUT} = +5 V or Adjustable +1.3 to +16 V, I_Q = 12 µA, I_{OUT} = 40 mA, w/Low Batt	1558
ADM666A	Tri-Mode, V_{IN} = +2 to +16.5 V, V_{OUT} = +3.3 V, +5 V, or Adj. +1.3 to +16 V, I_Q = 9 µA, I_{OUT} = 100 mA, w/Low Batt	1559
ADM690	V_{CC} & V_{BATT} Monitor +4.65 V, w/Watchdog Timer & On-Chip Battery Switch, Power-Fail Input +1.25 > 1.35 V, I_{OUT} = 100 mA	1562
ADM690A	V_{CC} & V_{BATT} Monitor +4.65 V, w/Watchdog Timer & On-Chip Battery Switch, Power-Fail Input +1.2 > 1.3 V, I_{OUT} = 250 mA	2077
ADM691	V_{CC} & V_{BATT} Monitor +4.65 V, w/Watchdog Timer & On-Chip Battery Switch, Power-Fail Input +1.25 > 1.35 V, I_{OUT} = 100 mA	1562
ADM691A	V_{CC} & V_{BATT} Monitor +4.65 V, w/Watchdog Timer & On-Chip Battery Switch, Power-Fail Input +1.2 > 1.3 V, I_{OUT} = 250 mA	2078
ADM692	V_{CC} & V_{BATT} Monitor +4.4 V, w/Watchdog Timer & On-Chip Battery Switch, Power-Fail Input +1.25 > 1.35 V, I_{OUT} = 100 mA	1562

Model Number	Description	Fax-code
ADM692A	V_{CC} & V_{BATT} Monitor +4.4 V, w/Watchdog Timer, On-Chip Battery Switch, Power-Fail Input +1.2 > 1.3 V, Reset = 200 msec Improved ADM690	2077
ADM693	V_{CC} & V_{BATT} Monitor +4.4 V, w/Watchdog Timer & On-Chip Battery Switch, Power-Fail Input +1.25 > 1.35 V, I_{OUT} = 100 mA	1562
ADM693A	V_{CC} & V_{BATT} Monitor +4.4 V, w/Watchdog Timer, On-Chip Battery Switch, Power-Fail Input +1.2 > 1.3 V Reset = 200 msec, V_{CC} = 4.5 > 5.5 V	2078
ADM694	V_{CC} & V_{BATT} Monitor w/Watchdog Timer & On-Chip Battery Switch, Reset = 100 msec, V_{CC} = 5 V ± 5%	1562
ADM695	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, RAM Write Protect & On-Chip Battery Switch, Reset = 280 msec, V_{CC} = 5 V ± 5%	1562
ADM696	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, RAM Write Protect & on chip Battery Switch, Reset = 70 msec, V_{CC} = 3 V to +5.5 V	1568
ADM697	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, RAM Write Protect, Reset = 70 msec, V_{CC} = 3 V to +5.5 V	1568
ADM698	+5 V Monitor, Generates Reset on Power-Up/Down, Output Low to V_{DD} = +1 V	1570
ADM699	+5 V Monitor, Generates Reset on Power-Up/Down, Output Low to V_{DD} = +1 V	1570
ADM705	µProcessor Reset Generator, Reset V_H = 4.65 V, Watchdog Timer In/Out	1865
ADM706	µProcessor Reset Generator, Reset V_H = 4.40 V, Watchdog Timer In/Out	1865
ADM706P	µProcessor Reset Generator, Reset V_H = 2.63 V, Watchdog Timer In/Out, Reset Negative True	1866
ADM706R	µProcessor Reset Generator, Reset V_H = 2.63 V, Watchdog Timer In/Out, Reset Positive True	1866
ADM706S	µProcessor Reset Generator, Reset V_H = 2.93 V, Watchdog Timer In/Out, Reset Negative True	1866
ADM706T	µProcessor Reset Generator, Reset V_H = 3.08 V, Watchdog Timer In/Out, Reset Negative True	1866
ADM707	µProcessor Reset Generator, Reset V_H = 4.65 V	1865
ADM708	µProcessor Reset Generator, Reset V_H = 4.40 V	1865
ADM708R	µProcessor Reset Generator, Reset V_H = 2.63 V	1866
ADM708S	µProcessor Reset Generator, Reset V_H = 2.93 V	1866
ADM708T	µProcessor Reset Generator, Reset V_H = 3.08 V	1866
ADM709	µProcessor Reset Generator, Reset L/M/R/S/T = 4.65/4.4/2.63/2.93/3.08 V_H, M = 4.4 V, Reset Delay = 20 µsec	1893
ADM800	V_{CC} & V_{BATT} Monitor L = +4.65 V, M = +4.4 V, w/Watchdog Timer, Batt. Switch, Power-Fail In +1.225 > 1.275 V, Reset = 200 msec	2078
ADM802L	V_{CC} & V_{BATT} Monitor +4.65 V, w/Watchdog Timer, Batt. Switch, Power-Fail In +1.225 > 1.275 V, Reset = 200 msec, Improved ADM690	2077
ADM802M	V_{CC} & V_{BATT} Monitor +4.4 V, w/Watchdog Timer, Batt. Switch, Power-Fail In +1.225 > 1.275 V, Reset = 200 msec, Improved ADM690	2077
ADM805L	V_{CC} & V_{BATT} Monitor +4.65 V, w/Watchdog Timer, Batt. Switch, Power-Fail In +1.2 > 1.3 V, Reset = 200 msec, Improved ADM690	2077
ADM805M	V_{CC} & V_{BATT} Monitor +4.4 V, w/Watchdog Timer, Batt. Switch, Power-Fail In +1.2 > 1.3 V, Reset = 200 msec, Improved ADM690	2077
ADM809	µProcessor Reset Generator, Active Low, I_Q = 17 µA, +3,+3.3,+5 V Versions, 140 msec, SOT-23 3-PIN	2159
ADM810	µProcessor Reset Generator, Active High, I_Q = 17 µA, +3,+3.3,+5 V Versions, 140 msec, SOT-23 3-PIN	2159
ADM811	µProcessor Reset Generator w/Manual Reset, Active Low, I_Q = 17 µA, +4.63, +4.38, +3.08, +2.93, +2.63 V, 140 msec	2180
ADM812	µProcessor Reset Generator w/Manual Reset, Active High, I_Q = 17 µA, +4.63, +4.38, +3.08, +2.93, +2.63 V, 140 msec	2180
ADM8660	Inverter +1.5 V > +7, to –1.2 > –7 V, I_{OUT} = 100 mA	1934
ADM8690	V_{CC} & V_{BATT} Monitor w/Watchdog Timer & On-Chip Batt. Switch, Reset = 50 msec, V_{CC} = 5 V ±5%, Improved ADM69x series	2144
ADM8691	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, Ram Write Protect & On-Chip Batt. Switch, Reset = 70 msec, Improved ADM69x series	2144
ADM8692	V_{CC} & V_{BATT} Monitor w/Watchdog Timer & On-Chip Batt. Switch, Reset = 50 msec, V_{CC} = 5 V ± 10%, Improved ADM69x series	2144
ADM8693	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, Ram Write Protect & On-Chip Batt. Switch, Reset = 70 msec, Improved ADM69x series	2144
ADM8694	V_{CC} & V_{BATT} Monitor w/Watchdog Timer & On-Chip Batt. Switch, Reset = 100 msec, Improved ADM69x series	2144
ADM8696	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, RAM Write Protect & On-Chip Batt. Switch, Reset = 70 msec, Improved ADM69x series	2145

Model Number	Description	Fax-code
ADM8697	V_{CC} & V_{BATT} Monitor w/Watchdog Timer, RAM Write Protect, Reset = 70 msec, V_{CC} = 3 V to +5.5 V, Improved ADM69x series	2145
ADM8698	+5 V Monitor, Generates Reset on Power-Up/Down, Output Low to V_{DD} = +1 V, Improved ADM69x Series	2162
ADM8699	+5 V Monitor, Generates Reset on Power-Up/Down, Output Low to V_{DD} = +1 V, Improved ADM69x Series	2162
ADM9240	6 Inputs, On-Chip Temp Sensor, 5 Digital Inputs for VID Bits, 2 Fan Speed Monitoring Inputs, LDCM Support, I2C	2442
ADM9261	Triple PC Voltage Monitor, With Manual Input, I_Q = 10 µA, V_{CC} = +2.5 > 3.6 V, Int Hysteresis, 8-Pin µSOIC	2207
ADM9264	Quad PC Voltage Monitor, +2.8 V, +3.3 V, +5 V and +12 V	2158
ADM9268	Quad PC Voltage Monitor, +2.8 V, +3.3 V, +5 V and +12 V, w/I^2C Interface	2443
ADM9690	Power Supply & PRGM Watchdog Timer 0.75/1.5/12.5/25 msec, Dual Low Reset Out Offset By 10 msec	2189
ADP667	Dual Mode, V_{IN} = +3.5 to +16.5 V, V_{OUT} = +5 V or Adjustable, +1.3 to +16 V, I_Q = 20 µA, I_{OUT} = 200 mA	1917
ADP1073	Step-Up or Step-Down, V_{IN} = +1.0 V, to 12.6 V, V_{OUT} = +3.3 V, +5 V +12 V or Adj., 40 mA @ 5 V from = 1.24 V	2015
ADP1108	Step-Up or Step-Down, V_{IN} = +2 V to +30 V, V_{OUT} = + 3.3 +5 +12 V or Adj., I_Q = 110 µA, 150 mA @ 5 V From +3 V	2017
ADP1109	Step-Up, V_{IN} = +2 V to +30 V, V_{OUT} = +3.3, +5, +12 V or Adj., I_Q = 580 µA, 100 mA @ +5 V From +3 V	2018
ADP1109A	Step-Up, V_{IN} = +2 V to +9 V, V_{OUT} = +3.3, +5, +12 V or Adj., I_Q = 580 µA, 100 mA @ +5 V From +3 V	2364
ADP1110	Step-Up or Step-Down, V_{IN} = +1 > 30 V, V_{OUT} = +3.3 V +5 V, +12 V or Adj., I_Q = 300 µA	2019
ADP1111	Step-Up or Step-Down, V_{IN} = +2 V to +30 V, V_{OUT} = +3.3 V, +5 V, +12 V or Adj., I_Q = 500 µA, 100 mA @ 5 V from +3 V	2020
ADP1147	Step-Down, V_{IN} = +3.5 V to 16 V, V_{OUT} = +3.3 V or +5 V, 250 kHz Constant Off Time, Eff = 95%, P Drive = 50 mA	2022
ADP1148	Step-Down, V_{IN} = +3.5 V to +20 V, V_{OUT} = +3.3 V or +5 V, 250 kHz, P (Primary) & N (Secondary) Nonoverlap Drives	2023
ADP1173	Step-Up or Step-Down, V_{IN} = +2 V to +30 V, V_{OUT} = 3.3, +5, +12 V, and Adj., I_Q = 110 µA, 80 mA @ 5 V from +3 V	2016
ADP3000	Step-Up or Step-Down, V_{IN} = +2 V to +30 V, V_{OUT} = + 3.3 V, +5 V, +12 V, and Adj., I_Q = 110 µA, 120 mA @ 3.3 V from +5 V	2028
ADP3050	Step-Down, V_{IN} = +3.6 V to +30 V, V_{OUT} = +3.3 V or +5 V or Adj. @ 2.5%, I_{OUT} = 1.2 A, I_Q = 4 mA, 300 kHz	2421
ADP3152	Dual N Channel Synchronous Driver 250 kHz, 5-Bit Prgm., +1.3 to +3.5 V Output, for Pentium PRO	2422
ADP3153	Dual N Channel Synchronous Driver 250 kHz, 5-Bit Prgm., +1.3 to +3.5 V Output, for Pentium PRO or II	2448
ADP3300	Step-Down, AnyCAP, V_{IN} = 2 > 16 V, V_{OUT} = +2.7, 3, 3.2, 3.3, 5 V, @ 1%, I_{OUT} = 50 mA, 400 kHz	2042
ADP3301	Single Output, AnyCAP, V_{IN} = 3 to 20 V, V_{OUT} +2.7, 3, 3.3, 5 V, 1%, I_{OUT} = 100 mA, Dropout = 120 mV	2013
ADP3302	Dual Output, AnyCAP, V_{IN} = 3 to 20 V, V_{OUT} = Combinations of +2.7, 3, 3.3, 5 V @1%, I_{OUT} = 100 mA	2014
ADP3303	Single Output, AnyCAP, V_{IN} = 3.5 to 20 V, V_{OUT} = +2.7, 3, 3..2, 3.3, 5 V, 0.5%, I_{OUT} = 250 mA	2043
ADP3306	Single Output, AnyCAP, V_{IN} = 3.2 > 12 V, V_{OUT} = 2.7 V, 3.0 V, 3.2 V, 3.3 V, 5 V @ 1.0%, I_{OUT} = 300 mA	2236
ADP3307	Single Output, AnyCAP, V_{IN} = 3 > 12 V, V_{OUT} = 2.7 V, 3.0 V, 3.3 V @ 0.8%, I_{OUT} = 100 mA, Dropout = 160 mV	2300
ADP3308	Single Output, AnyCAP, V_{IN} = 2 > 16 V, V_{OUT} = +2.7, 3, 3.2, 3.3, 5 V, 0.8%, I_{OUT} = 50 mA, Pins with LP2980	2301
ADP3309	Single Output, AnyCAP, V_{IN} = 3 > 12 V, V_{OUT} = 2.7 V, 3.0 V, 3.3 V @ 0.8%, I_{OUT} = 100 mA, @ 100 mA, Pins with LP2950	2423
ADP3310	Positive Controller, +5 V Input, V_{OUT} = +2.8, 3.0, 3.3, 5.0 @ 5.6 Amps w/EXT Pass Transistor IRFR9024, w/Sdown	2120
ADP3367	Dual Mode, V_{IN} = +3.5 to +16.5 V, V_{OUT} = +5 V or Adjustable, +1.3 to +16 V, I_Q = 17 µA, I_{OUT} = 200 mA, ESD = 6000 V	1913

Model Number	Description	Fax-code
ADP3603	Inverter, V_{IN} = +4.5 V to +6 V, –3.0 V_{OUT} @ 2%, 50 mA, Regulated Output, I_Q = 10 mA, 1 mA in Shutdown	1982
ADP3604	Inverter, V_{IN} = +4.5 V to +6 V, –3.0 V_{OUT} @ 2%, 120 mA, Regulated Output, I_Q = 10 mA, 1 mA in Shutdown	2051
ADP3605	Inverter, V_{IN} = +4.5 V to +6 V, –3.0 V_{OUT} @ 2%, 120 mA, Regulated Output, I_Q = 10 mA, 1 mA in Shutdown	2198
ADP3607	Voltage Converter, V_{IN} = +4.5 V to +6 V, Step-Up without Inductor, 120 mA, 250 kHz, Regulated Output, I_Q = 10 mA	2199
ADP3801	Switching, Li-Ion, MicCad, and NiMH; 200 kHz; Pin Programmable Chemistry and Cell Number	2200
ADP3802	Switching, Li-Ion, MicCad, and NiMH; 500 kHz; Pin Programmable Chemistry and Cell Number	2200
ADP3810	Switching, Trimmed Internal resistor Divider, V_{OUT} = +4.2, +8.4, +6.0, +16.8, @ 1% Accuracy	2069
ADP3811	Switching, NiCad or NiMH, External Resistors Set the Voltage Limit, 2% Accuracy	2069
ADP3820	Linear V_{IN} = +3.5 to +16.5 V, V_{OUT} = +5 V or Adjustable, +1.3 to +16 V, I_Q = 20 µA, I_{OUT} = 200 mA	1917
ADR290	+2.048 V, I_Q = 10 µA, Initial Accuracy - 1/2/5 mV, I_{OUT} = 5 mA, XFET Low Noise/Hysteresis	2110
ADR291	+2.50 V, I_Q = 10 µA, Initial Accuracy - 1/2/5 mV, I_{OUT} = 5 mA, XFET Low Noise/Hysteresis	2110
ADR292	+4.0960 V, I_Q = 10 µA, Initial Accuracy - 1/2/5 mV, I_{OUT} = 5 mA, XFET Low Noise/Hysteresis	2110
ADR293	+5.0 V, I_Q = 15 µA, Initial Accuracy-0.1%/0.5%, I_{OUT} = 5 mA, XFET Low Noise/Hysteresis	2255
ADT14	Quad Setpoint Controller, Pin Strap Thermal Hysteresis = 0.65/1.5/5°C, $V_{THRESHOLD}$ +4.5 to +13.2 V	2026
ADT45	Temp Range –40 to +125°C, V_{OUT} = 250 mV, TC = 10m/°C, I_Q = 50 µA, Accy. = ±2°C, V_{IN} = +2.7 to +12 V, SOT-23, Pins to LM45	2257
ADT50	Temp Range –40 to +125°C, V_{OUT} = 750 mV, TC = 10m/°C, I_Q = 50 µA, Accy. = ±2°C, V_{IN} = +2.7 to +12 V, SOT-23, Pins to LM50	2257
ADT70	Platinum (P) RTD Signal Conditioner, w/Dual 1 mA Current Source, Gain = 1.3 mV/Ohm, Rail-to-Rail I/A	2123
REF01	+10 V, V_{OS} = 3/5 mV, TCVo = 8.5 to 65 ppm, Bandgap	1755
REF02	+5 V, V_{OS} = ±15/25 mV, TCVo = 8.5 to 250 ppm, Line Regulation = 0.01%/V, Bandgap	1756
REF191	+2.048 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF192	+2.5 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF193	+3.0 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF194	+4.5 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF195	+5.0 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF196	+3.3 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF198	+4.096 V, I_Q = 45 µA, Initial Accuracy = 2/5/10 mV, I_{OUT} = 30 mA, Bandgap	1761
REF43	+2.5 V, V_{OS} = ±15/25 mV, TCVo = 6 to 10 ppm, Line Regulation = 2 ppm/V, Bandgap	1762
TMP01	Temp Range = -55 to +125°C, Prgm. Window Comparator, Prgm Comparator Hysteresis, Temp Output = 5 mV/Kelvin	1807
TMP03	Temperature Sensor, Duty Cycle Modulated Output @ 35 Hz, –40 > +100°C, +5 V @ 1 mA, Open Collector	1850
TMP04	Temperature Sensor, Duty Cycle Modulated Output @ 35 Hz, –40 > +100°C, +5 V @ 1 mA, TTL/CMOS	1850
TMP12	Airflow and Temperature Sensor, 100 ohm Heater for Emulating Power IC or Pentium CPU	1970
TMP17	Temperature Sensor, Current Output I = 1 µA/Degree Kelvin, –40 to +105°C, AD590 in 8-Lead SOIC	2040
TMP35	Temp Range –40 +150°C, Accuracy = ±2 or 3°C, V_{OUT} = 250 mV ± 10 mV/°C, I_Q = 50 µA, V = +2.7 > +5.5 V	1972
TMP36	Temp Range –40 +150°C, Accuracy = ±2 or 3°C, V_{OUT} = 750 mV ± 10 mV/°C, I_Q = 50 µA, V = +2.7 > +5.5 V	1972
TMP37	Temp Range –40 +150°C, Accuracy = ±2 or 3°C, V_{OUT} = 500 mV ± 20 mV/°C, I_Q = 50 µA, V = +2.7 > +5.5 V	1972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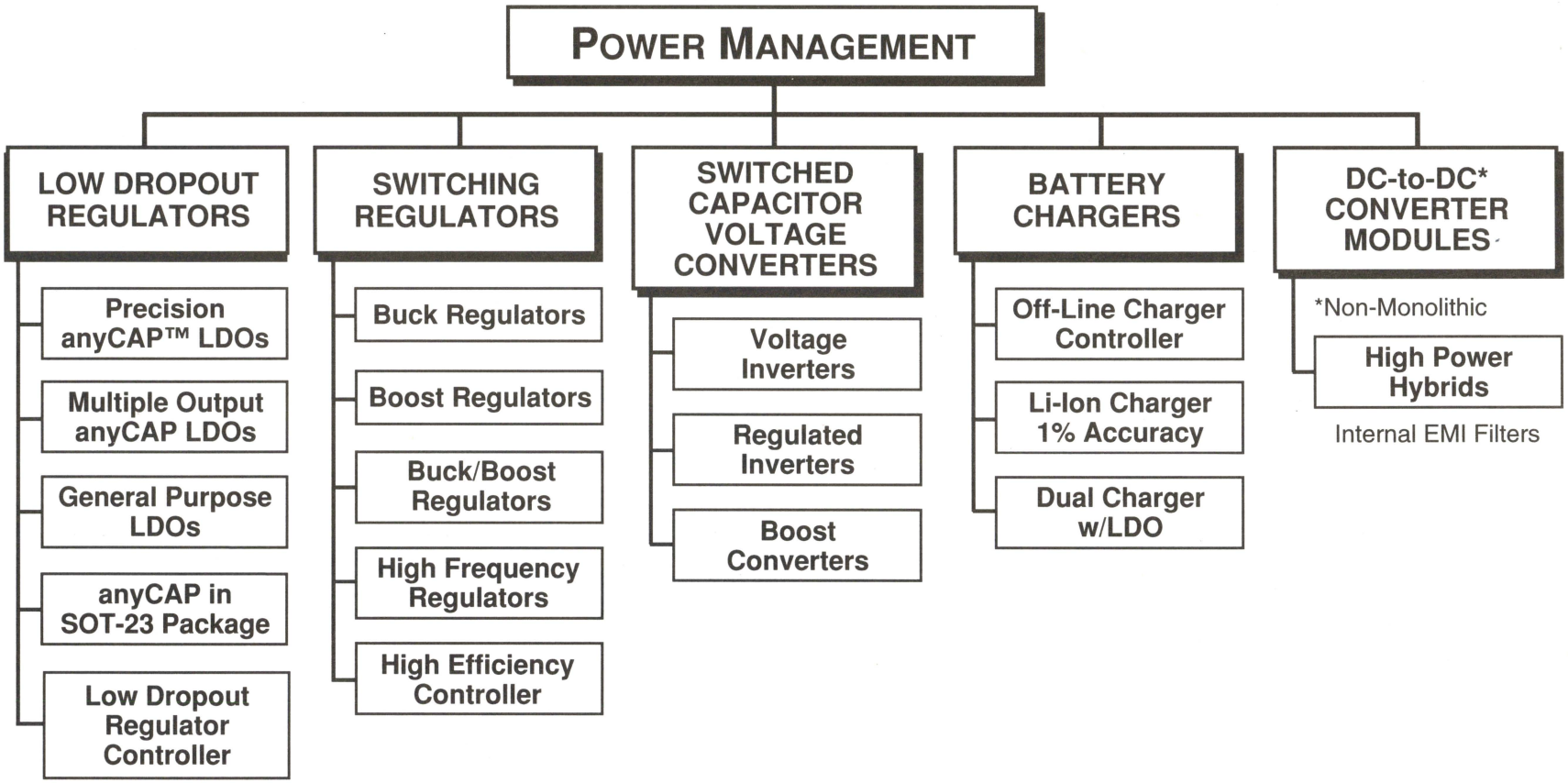
Low Dropout Regulators

2



anyCAP is a trademark of Analog Devices, Inc.

LOW DROPOUT REGULATORS

PRECISION anyCAP-LDOs

▶ ADP3300/**ADP3308** (50 mA)
V_{IN}: +3 V to +16 V
V_{OUT}: +2.7 V, +3 V, +3.2 V, +3.3 V, +5 V
SOT-23: 6/5 Pins

ADP3301 (100 mA)
V_{IN}: +3 V to +12 V
V_{OUT}: +2.7 V, +3 V, +3.2 V, +3.3 V, +5 V
SO-8 Package

ADP3302 (100 mA)
V_{IN}: +3 V to +12 V
V_{OUT}: +3 V, +3.2 V, +3.3 V, +5 V
SO-8 Package

ADP3303 (200 mA)
V_{IN}: +3.2 V to +12 V
V_{OUT}: +2.7 V, +3 V, +3.2 V, +3.3 V, +5 V
SO-8 Package

▶ **ADP3306** (300 mA)
V_{IN}: +3.2 V to +12 V
V_{OUT}: +2.7 V, +3 V, +3.2 V, +3.3 V, +5 V
SO-8 and TSSOP Packages

▶ **ADP3307**/**ADP3309** (100 mA)
V_{IN}: +3 V to +12 V
V_{OUT}: +2.7 V, +3 V, +3.3 V
SOT-23: 6/5 Pins

MULTIPLE OUTPUT anyCAP-LDOs

ADP3302 (100 mA)
V_{IN}: +3 V to +12 V
V_{OUT}: +3 V, +3.2 V, +3.3 V, +5 V
SO-8 Package, Dual Error Flag

GENERAL PURPOSE LDOs

ADM663/
ADM663A (100 mA)
V_{IN}: +2 V to +16.5 V
V_{OUT}: +3.3 V, +5 V, Adj.
SO-8 Package

ADM666/
ADM666A (100 mA)
V_{IN}: +2 V to +16.5 V
V_{OUT}: 3.3 V, +5 V, Adj.
Low Battery Detection

ADP667 (200 mA)
V_{IN}: +3.5 V to +16.5 V
V_{OUT}: +5 V, Adj.
SO-8 Package

ADP3367 (300 mA)
V_{IN}: +2.5 V to +16.5 V
V_{OUT}: +5 V, Adj.
SO-8 Package

anyCAP in SOT-23 PACKAGE

▶ ADP3300/**ADP3308** (50 mA)
V_{IN}: +3 V to +16 V
V_{OUT}: +2.7 V, +3 V, +3.2 V, +3.3 V, +5 V
SOT-23: 6/5 Pins

▶ **ADP3307**/**ADP3309** (100 mA)
V_{IN}: +3 V to +12 V
V_{OUT}: +2.7 V, +3 V, +3.3 V
SOT-23: 6/5 Pins

LOW DROPOUT REGULATOR CONTROLLER

ADP3310 (I_Q: 800 mA)
V_{IN}: +2.5 V to +15 V
V_{OUT}: +2.8 V, +3 V, +3.3 V, +5 V
SO-8 Package

▶ = New Product since *1997 Short Form Designers' Guide.*

Power Management
Low Dropout Regulators: DC-to-DC

Model	Input Voltage Range Volts	V_{OUT} Options Volts	Dropout Voltage V @ I_{MAX}	I_{OUT} mA	I_Q @ I_{OUT} max µA	V_{OUT} Accuracy @ 25°C/Temp %	Low V_{BATT} Detect	I_{OUT} Sense	# Pins	Lowest Grade Price 100s	Comments	Fax-code
Single Output												
ADP3367	2.5 to 16.5	5, Adj.	0.15	200	17	2	Yes	No	8	$3.07	6 kV ESD Protection	1913
ADP667	3.5 to 16.5	5, Adj.	0.15	200	20	4	Yes	No	8	$2.28		1917
ADM663	2 to 16.5	5, Adj.	1.0	40	12	5	No	Yes	8	$1.54	V_{TEMP} + I_{OUT} Sense	1558
ADM666	2 to 16.5	5, Adj.	1.0	40	12	5	Yes	No	8	$1.82		1558
Single Output anyCAP												
▶ **ADP3300**	**3 to 16**	**2.7, 3, 3.2, 3.3, 5**	**0.1**	**50**	**100**	**0.8/1.4**	**No**	**No**	**3**	**$1.25**		**2042**
▶ **ADP3308**	**3 to 16**	**2.7, 3, 3.2, 3.3, 5**	**0.1**	**50**	**100**	**0.8**	**No**	**No**	**5**	**$1.25**	**LP2980 Pinout**	**2302**
▶ **ADP3309**	**3 to 12**	**2.7, 3, 3.2, 3.3, 5**	**0.16**	**100**	**100**	**0.8**	**No**	**No**	**5**	**$1.25**	**LP2950 Pinout**	**2423**
ADP3301	3 to 12	2.7, 3, 3.2, 3.3, 5	0.1	100	100	0.8/1.4	No	No	8*	$1.25	Loss of Reg. Flag	2013
ADP3303	3 to 12	2.7, 3, 3.2, 3.3, 5	0.18	200	100	0.8/1.4	No	No	8*	$1.43	Loss of Reg. Flag	2043
▶ **ADP3306**	**3.2 to 12**	**2.7, 3, 3.2, 3.3, 5**	**0.3**	**300**	**100**	**1/1.5**	**No**	**No**	**8***	**$2.02**	**14-Lead TSSOP Also**	**2236**
▶ **ADP3307**	**3 to 12**	**2.7, 3, 3.2, 3.3, 5**	**0.16**	**100**	**100**	**0.8/1.5**	**No**	**No**	**3**	**$1.25**		**2301**
Dual Output anyCAP**												
ADP3302	3 to 12	2.7, 3, 3.2, 3.3, 5	0.1	100	100	0.8/1.4	No	No	8*	$1.90		2014
Selectable Output												
ADM663A	2 to 16.5	5	100	100	6	5	No	Yes	8	$1.76	V_{SET} = GND, V_{TEMP} Out	1559
ADM663A	2 to 16.5	3.3	100	100	6	5	No	Yes	8	$1.76	V_{SET} = V_{IN}, V_{TEMP} Out	1559
ADM666A	2 to 16.5	5	100	100	6	5	Yes	No	8	$2.02	V_{SET} = GND	1559
ADM666A	2 to 16.5	3.3	100	100	6	5	Yes	No	8	$2.02	V_{SET} = V_{IN}	1559
Regulator Controller												
ADP3310	2.5 to 15	2.8, 3, 3.3, 5	0.07	1000	1	1.5	No	No	8	$1.10	W/External NDP6020F	2120

*Thermal Coastline Package
**No restriction on ESR of cap used.
▶ = New Product since *1997 Short Form Designer's Guide.*

+5 V Fixed, Adjustable Micropower Linear Voltage Regulators

ADM663/ADM666

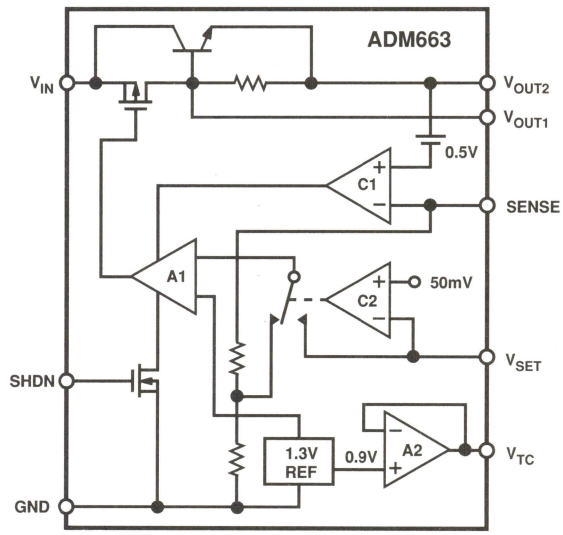
FEATURES

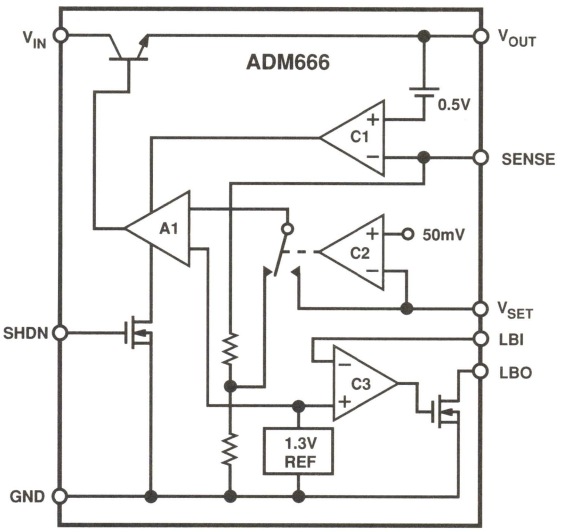
5 V Fixed or +1.3 V to +16 V Adjustable
Low Power CMOS: 12 mA max Quiescent Current
40 mA Output Current
Current Limiting
Pin Compatible with MAX663/666
+2 V to +16.5 V Operating Range
Low Battery Detector ADM666
No Overshoot on Power-Up

APPLICATIONS

Handheld Instruments
LCD Display Systems
Pagers
Remote Data Acquisition

FUNCTIONAL BLOCK DIAGRAMS





GENERAL DESCRIPTION

The ADM663/ADM666 are precision voltage regulators featuring a maximum quiescent current of 12 μA. They can be used to give a fixed +5 V output with no additional external components or can be adjusted from 1.3 V to 16 V using two external resistors. Fixed or adjustable operation is automatically selected via the V_{SET} input. The low quiescent current makes these devices especially suitable for battery powered systems. The input voltage range is 2 V to 16.5 V and an output current up to 40 mA is provided. The ADM663 can directly drive an external pass transistor for currents in excess of 40 mA. Additional features include current limiting and low power shutdown. Thermal shutdown circuitry is also included for additional safety.

The ADM666 features additional low battery monitoring circuitry to detect for low battery voltages.

The ADM663/ADM666 are pin-compatible replacements for the MAX663/666. Both are available in 8-pin DIP and in narrow surface mount (SOIC) packages.

ORDERING GUIDE

Model	Temperature Range	Package Option
ADM663AN	–40°C to +85°C	N-8
ADM663AR	–40°C to +85°C	R-8
ADM666AN	–40°C to +85°C	N-8
ADM666AR	–40°C to +85°C	R-8

REV. 0

Tri-Mode: +3.3 V, +5 V, Adjustable Micropower Linear Voltage Regulators

ADM663A/ADM666A*

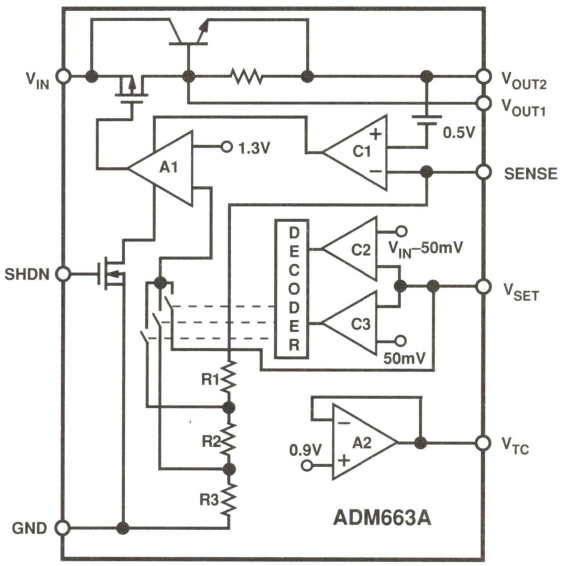
FEATURES

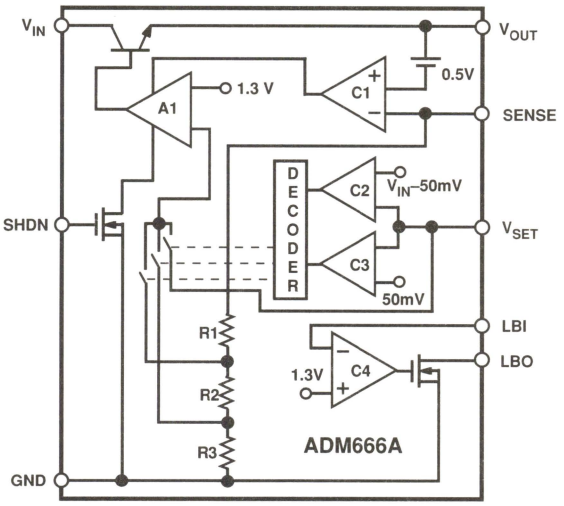
Tri-Mode Operation
3.3 V, 5 V Fixed or +1.3 V to +16 V Adjustable
Low Power CMOS: 9 μA max Quiescent Current
High Current 100 mA Output
Low Dropout Voltage
Upgrade for ADM663/ADM666
"Small" 0.1 μF Output Capacitor (0805 Style)
+2 V to +16.5 V Operating Range
Low Battery Detector ADM666A
No Overshoot on Power-Up
Thermal Shutdown

APPLICATIONS

Handheld Instruments
LCD Display Systems
Pagers
Battery Operated Equipment

FUNCTIONAL BLOCK DIAGRAMS





GENERAL DESCRIPTION

The ADM663A/ADM666A are precision linear voltage regulators featuring a maximum quiescent current of 9 μA. They can be used to give a fixed +3.3 V or +5 V output with no additional external components or can be adjusted from 1.3 V to 16 V using two external resistors. Fixed or adjustable operation is automatically selected via the V_{SET} input. The low quiescent current makes these devices especially suitable for battery powered systems. The input voltage range is 2 V to 16.5 V, and an output current up to 100 mA is provided. Current limiting may be set using a single external resistor. For additional safety, an internal thermal shutdown circuit monitors the internal die temperature.

The ADM666A features additional low battery monitoring circuitry to detect for low battery voltages.

The ADM663A/ADM666A are pin compatible enhancements for the ADM663/ADM666. Improvements include an additional 3.3 V output range, higher output current, and operation with a small output capacitor.

The ADM663A/ADM666A are available in an 8-pin DIP and narrow surface mount (SOIC) packages.

*Patent pending.

REV. 0

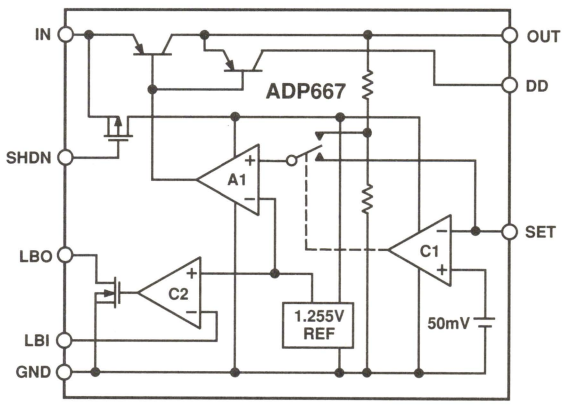
+5 V Fixed, Adjustable Low-Dropout Linear Voltage Regulator

ADP667

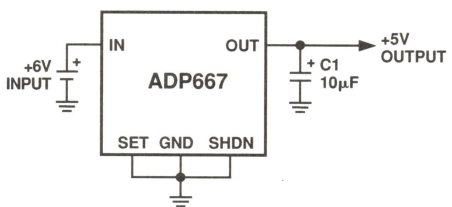
FEATURES
Low-Dropout: 150 mV @ 200 mA
Low Power CMOS: 20 μA Quiescent Current
Shutdown Mode: 0.2 μA Quiescent Current
250 mA Output Current
Pin Compatible with MAX667
Stable with 10 μF Load Capacitor
Low Battery Detector
Fixed +5 V or Adjustable Output
+3.5 V to +16.5 V Input Range
Dropout Detector Output

APPLICATIONS
Handheld Instruments
Cellular Telephones
Battery Operated Devices
Portable Equipment
Solar Powered Instruments
High Efficiency Linear Power Supplies

FUNCTIONAL BLOCK DIAGRAM



TYPICAL OPERATING CIRCUIT



GENERAL DESCRIPTION

The ADP667 is a low-dropout precision voltage regulator that can supply up to 250 mA output current. It can be used to give a fixed +5 V output with no additional external components or can be adjusted from +1.3 V to +16 V using two external resistors. Fixed or adjustable operation is automatically selected via the SET input. The low quiescent current (20 μA) in conjunction with the standby or shutdown mode (0.2 μA) makes this device especially suitable for battery powered systems. The dropout voltage when supplying 100 μA is only 5 mV allowing operation with minimal headroom and prolonging the battery useful life. At higher output current levels the dropout remains low increasing to just 150 mV when supplying 200 mA. A wide input voltage range from 3.5 V to 16.5 V is allowable.

Additional features include a dropout detector and a low supply/battery monitoring comparator. The dropout detector can be used to signal loss of regulation, while the low battery detector can be used to monitor the input supply voltage.

The ADP667 is a pin-compatible replacement for the MAX667. It is specified over the industrial temperature range –40°C to +85°C and is available in an 8-pin DIP and in narrow surface mount (SOIC) packages.

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option
ADP667AN	–40°C to +85°C	8-Pin Plastic DIP	N-8
ADP667AR	–40°C to +85°C	8-Lead SOIC	SO-8

REV. 0

High Accuracy anyCAP 50 mA Low Dropout Linear Regulator

ADP3300

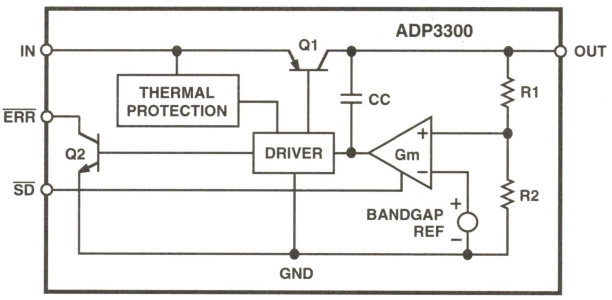
FEATURES

High Accuracy (Over Line and Load Regulations at 25°C): ±0.8%
Ultralow Dropout Voltage: 80 mV Typical @ 50 mA
Requires Only C_O = 0.47 µF for Stability
anyCAP = Stable with All Types of Capacitors (Including MLCC)
Current and Thermal Limiting
Low Noise
Dropout Detector
Low Shutdown Current: 1 µA
3.0 V to 12 V Supply Range
–40°C to +85°C Ambient Temperature Range
Several Fixed Voltage Options
Ultrasmall SOT-23 6-Lead Package
Excellent Line and Load Regulations

APPLICATIONS

Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
PCMCIA Regulators
Bar Code Scanners
Camcorders, Cameras

FUNCTIONAL BLOCK DIAGRAM



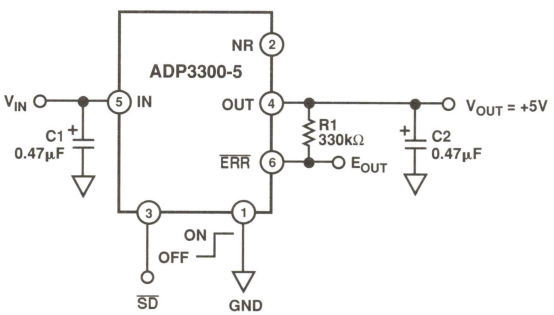


Figure 1. Typical Application Circuit

GENERAL DESCRIPTION

The ADP3300 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. The ADP3300 stands out from conventional LDOs with a novel architecture and an enhanced process. Its patented design requires only a 0.47 µF output capacitor for stability. This device is stable with any capacitor, regardless of its ESR (Equivalent Series Resistance) value, including ceramic types (MLCC) for space restricted applications. The ADP3300 achieves exceptional accuracy of ±0.8% at room temperature and ±1.4% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3300 is only 80 mV (typical) at 50 mA.

The ADP3300 operates with a wide input voltage range from 3.0 V to 12 V and delivers a load current in excess of 50 mA. It features an error flag that signals when the device is about to lose regulation or when the short circuit or thermal overload protection is activated. Other features include shutdown and optional noise reduction capabilities. The ADP330x anyCAP LDO family offers a wide range of output voltages and output current levels from 50 mA to 300 mA:

ADP3301 (100 mA)
ADP3302 (100 mA, Dual Output)
ADP3304 (100 mA, Dual Output with Separate Grounds)
ADP3303 (200 mA)
ADP3306 (300 mA)

High Accuracy anyCAP 100 mA Low Dropout Linear Regulator

ADP3301

FEATURES

High Accuracy (Over Line and Load Regulations at +25°C): ±0.8%
Ultralow Dropout Voltage: 100 mV Typical @ 100 mA
Requires Only C_O = 0.47 μF for Stability
anyCAP = Stable with All Types of Capacitors
Current and Thermal Limiting
Low Noise
Dropout Detector
Low Shutdown Current: 1 μA
Several Fixed Voltage Options
3.0 V to 12 V Supply Range
–20°C to +85°C Ambient Temperature Range
Thermally Enhanced SO-8 Package
Excellent Line and Load Regulations

APPLICATIONS

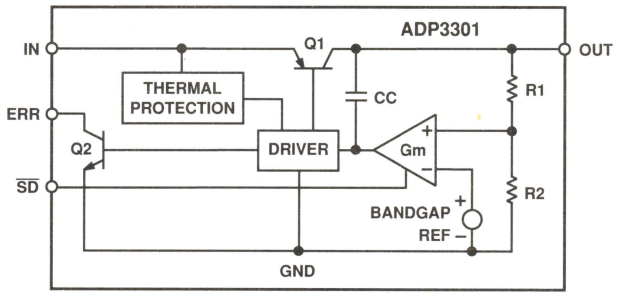
Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
Portable Instruments
Post Regulator for Switching Supplies
Bar Code Scanners

GENERAL DESCRIPTION

The ADP3301 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. The ADP3301 stands out from the conventional LDOs with a novel architecture, an enhanced process and a new package. Its patented design includes a noninverting wideband driver and a stage that permits the use of an internal "pole splitting" capacitor to stabilize the feedback loop with a single output capacitor as small as 0.47 μF. This device is stable with any type of capacitor regardless of its ESR (Equivalent Serial Resistance) value, including ceramic types (MLCC) for space restricted applications. The ADP3301 achieves exceptional accuracy of ±0.8% at room temperature and ±1.4% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3301 is only 100 mV (typical) at 100 mA.

In addition to the new architecture and process, ADI's new proprietary thermally enhanced package (Thermal Coastline) can handle 1 W of power dissipation without external heat sink or large copper surface on the PC board. This keeps PC board real estate to a minimum and makes the ADP3301 very attractive for use in portable equipment.

FUNCTIONAL BLOCK DIAGRAM



The ADP3301 operates with a wide input voltage range from 3 V to 12 V and delivers a load current in excess of 100 mA. It features an error flag that signals when the device is about to lose regulation or when the short circuit or thermal overload protection is activated. Other features include shutdown and optional noise reduction capabilities. The ADP330x anyCAP LDO family offers a wide range of output voltages and output current levels from 50 mA to 300 mA:

ADP3300 (50 mA, SOT-23)
ADP3302 (100 mA, Dual Output)
ADP3304 (100 mA, Dual Output with Separate Grounds)
ADP3303 (200 mA)
ADP3306 (300 mA)

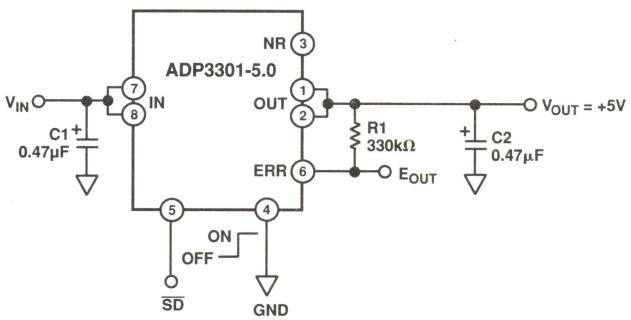


Figure 1. Typical Application Circuit

REV. 0

High Precision anyCAP Dual Low Dropout Linear Regulator

ADP3302

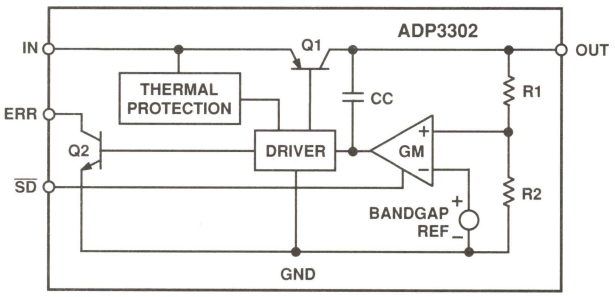
FEATURES

High Accuracy: ±0.8%
Ultralow Dropout Voltage: 120 mV @ 100 mA Typical
Requires only C_O = 0.47 μF for Stability
anyCAP = Stable with All Types of Capacitors
Current and Thermal Limiting
Low Noise
Dropout Detector
Multiple Voltage Options
Thermally Enhanced SO-8 Package

APPLICATIONS

Cellular Telephones
Notebook and Palmtop Computers
Battery Powered Systems
Portable Instruments
High Efficiency Linear Regulators

FUNCTIONAL BLOCK DIAGRAM
(1/2 IS SHOWN)



GENERAL DESCRIPTION

The ADP3302 is a member of the ADP330X family of precision micropower low dropout anyCAP regulators. The ADP3302 contains two fully independent 100 mA regulators with separate shutdown and merged error outputs. It features 1.4% overall output accuracy and very low, 120 mV typical, dropout voltage.

The ADP3302 has a wide input voltage range from +3 V to +12 V. It features an error flag that signals when either of the two regulators is about to lose regulation. It has short circuit current protection as well as thermal shutdown.

The ADP3302's enhanced lead frame design allows for a maximum power dissipation of 630 mW @ +70°C ambient temperature and 1.0 W at room temperature without any external heat sink.

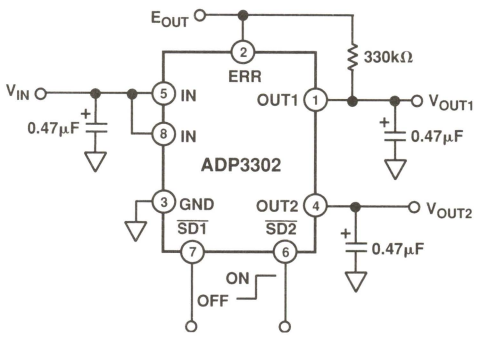


Figure 1. Application Circuit

REV. 0

High Accuracy anyCAP 200 mA Low Dropout Linear Regulator

ADP3303

FEATURES

High Accuracy Over Line and Load Regulations at 25°C: ±0.8%
Ultralow Dropout Voltage: 180 mV Typical @ 200 mA
Requires Only C_O = 0.47 µF for Stability
anyCAP = Stable with All Types of Capacitors (Including MLCC)
Current and Thermal Limiting
Low Noise
Dropout Detector
Low Shutdown Current: 1 µA
Several Fixed Voltage Options
3.2 V to 12 V Supply Range
–20°C to +85°C Ambient Temperature Range
Thermally Enhanced SO-8 Package
Excellent Line and Load Regulations

APPLICATIONS

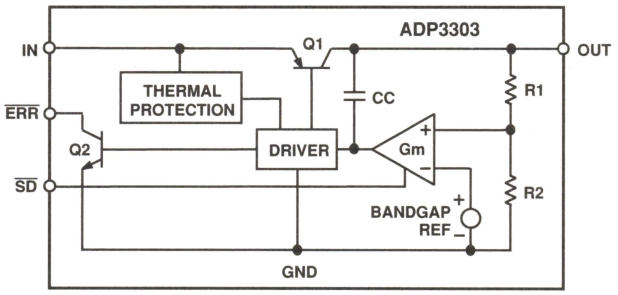
Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
Portable Instruments
Post Regulator for Switching Supplies
Bar Code Scanners

GENERAL DESCRIPTION

The ADP3303 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. The ADP3303 stands out from the conventional LDOs with a novel architecture, an enhanced process and a new package. Its patented design requires only a 0.47 µF output capacitor for stability. This device is stable with any capacitor regardless of its ESR (Equivalent Series Resistance) value, including ceramic types (MLCC) for space restricted applications. The ADP3303 achieves exceptional accuracy of ±0.8% at room temperature and ±1.4% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3303 is only 180 mV (typical) at 200 mA.

In addition to the new architecture and process, ADI's new proprietary thermally enhanced package (Thermal Coastline) can handle 1 W of power dissipation without external heatsink or large copper surface on the PC board. This keeps PC board real estate to a minimum and makes the ADP3303 very attractive for use in portable equipment.

FUNCTIONAL BLOCK DIAGRAM



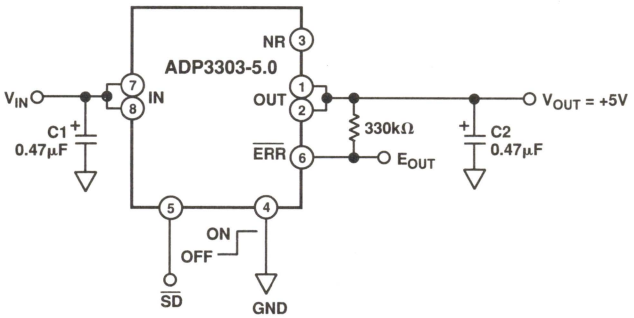


Figure 1. Typical Application Circuit

The ADP3303 operates with a wide input voltage range from 3.2 V to 12 V and delivers a load current in excess of 200 mA. It features an error flag that signals when the device is about to lose regulation or when the short circuit or thermal overload protection is activated. Other features include shutdown and optional noise reduction capabilities. The ADP330x anyCAP LDO family offers a wide range of output voltages and output current levels from 50 mA to 300 mA:

ADP3300 (50 mA, SOT-23)
ADP3301 (100 mA)
ADP3302 (100 mA, Dual Output)
ADP3304 (100 mA, Dual Output with Separate Grounds)
ADP3306 (300 mA)

REV. 0

High Accuracy anyCAP 300 mA Low Dropout Linear Regulator

ADP3306

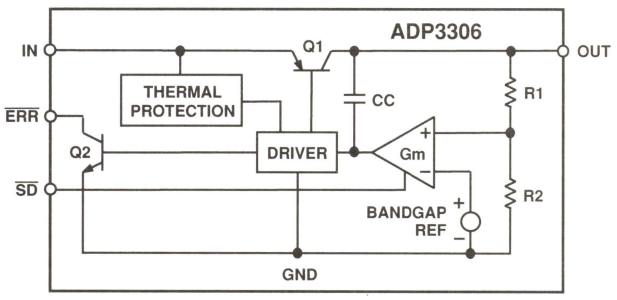
FEATURES

High Accuracy Over Line and Load Regulations at 25°C: ±1%
Ultralow Dropout Voltage: 300 mV Typical @ 300 mA
Requires Only C_O = 1 μF for Stability
anyCAP = Stable with All Types of Capacitors (Including MLCC)
Current and Thermal Limiting
Low Noise
Dropout Detector
Low Shutdown Current: 1 μA
Several Fixed Voltage Options
3.2 V to 12 V Supply Range
–20°C to +85°C Ambient Temperature Range
Thermally Enhanced SO-8 and TSSOP-14 Packages
Excellent Line and Load Regulations

APPLICATIONS

Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
Portable Instruments
Post Regulator for Switching Supplies
Bar Code Scanners

FUNCTIONAL BLOCK DIAGRAM



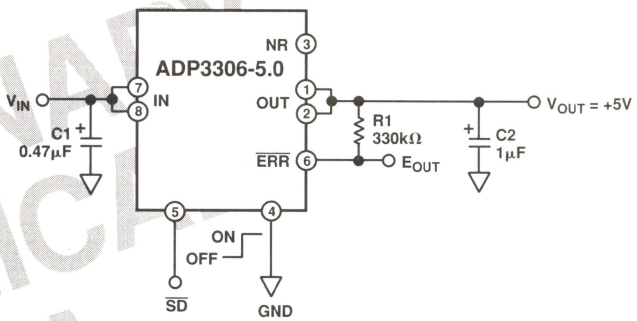


Figure 1. Typical Application Circuit

GENERAL DESCRIPTION

The ADP3306 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. The ADP3306 stands out from the conventional LDOs with a novel architecture, an enhanced process and a new package. Its patented design requires only a 1 μF output capacitor for stability. This device is stable with any capacitor, regardless of its ESR (Equivalent Series Resistance) value, including ceramic types (MLCC) for space restricted applications. The ADP3306 achieves exceptional accuracy of ±1.0% at room temperature and ±1.5% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3306 is only 300 mV (typical) at 300 mA.

In addition to the new architecture and process, ADI's new proprietary thermally enhanced package (Thermal Coastline) can handle 1 W of power dissipation without external heat sink or large copper surface on the PC board. This keeps PC board real estate to a minimum and makes the ADP3306 very attractive for use in portable equipment.

The ADP3306 operates with a wide input voltage range from 3.2 V to 12 V and delivers a load current in excess of 300 mA. It features an error flag that signals when the device is about to lose regulation or when the short circuit or thermal overload protection is activated. Other features include shutdown and optional noise reduction capabilities. The ADP330x anyCAP LDO family offers a wide range of output voltages and output current levels from 50 mA to 300 mA:

ADP3300 (50 mA, SOT-23)
ADP3307 (100 mA, SOT-23)
ADP3301 (100 mA)
ADP3302 (100 mA, Dual Output)
ADP3304 (100 mA, Dual Output with Separate Grounds)
ADP3303 (200 mA)

High Accuracy anyCAP 100 mA Low Dropout Linear Regulator

ADP3307

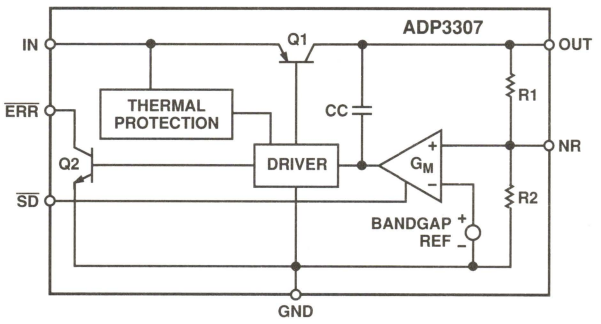
FEATURES

0.8% Accuracy Over Line and Load Regulations @ +25°C
Ultralow Dropout Voltage: 120 mV Typical @ 100 mA
Requires only C_O = 0.47 μF for Stability
anyCAP = Stable with All Types of Output Capacitors (Including MLCC)
Current and Thermal Limiting
Low Noise
Dropout Detector
Low Shutdown Current: 1 μA
3.0 V to 12 V Supply Range
–20°C to +85°C Ambient Temperature Range
Several Fixed Voltage Options
Ultrasmall SOT-23-6 (RT-6) Package
Excellent Line and Load Regulations

APPLICATIONS

Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
PCMCIA Regulator
Bar Code Scanners
Camcorders, Cameras

FUNCTIONAL BLOCK DIAGRAM



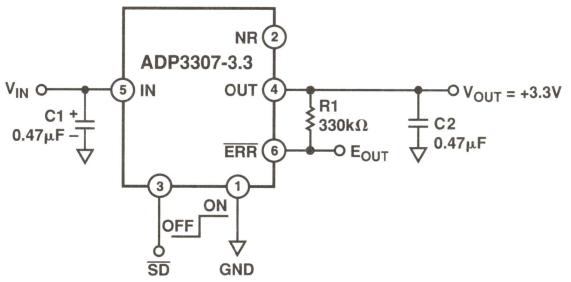


Figure 1. Typical Application Circuit

GENERAL DESCRIPTION

The ADP3307 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. The ADP3307 stands out from the conventional LDOs with a novel architecture and an enhanced process. Its patented design requires only a 0.47 μF output capacitor for stability. This device is stable with any type of capacitor regardless of its ESR (Equivalent Series Resistance) value, including ceramic types (MLCC) for space restricted applications. The ADP3307 achieves exceptional accuracy of ±0.8% at room temperature and ±1.4% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3307 is only 120 mV (typical) at 100 mA.

The ADP3307 operates with a wide input voltage range from 3.0 V to 12 V and delivers a load current in excess of 100 mA. It features an error flag that signals when the device is about to lose regulation or when the short circuit or thermal overload protection is activated. Other features include shutdown and optional noise reduction capabilities. The ADP330x anyCAP LDO family offers a wide range of output voltages and output current levels from 50 mA to 300 mA:

ADP3300 (50 mA, SOT-6)
ADP3307 (100 mA, SOT)
ADP3301 (100 mA, SO-8)
ADP3302 (100 mA, Dual Output)
ADP3303 (200 mA)
ADP3306 (300 mA)

anyCAP 50 mA Low Dropout Linear Regulator

ADP3308

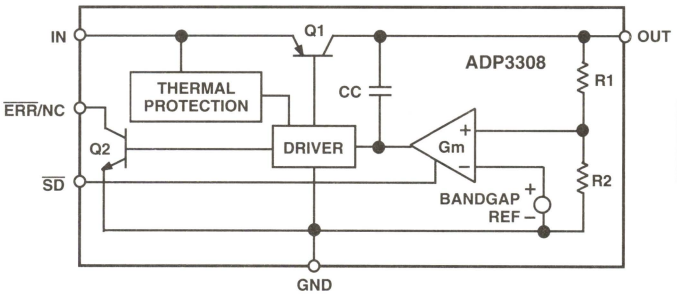
FEATURES

±1.2% Accuracy Over Line and Load Regulations @ 25°C
Ultralow Dropout Voltage: 100 mV Typical @ 50 mA
Requires Only C_O = 0.47 μF for Stability
anyCAP = Stable with All Types of Capacitors (Including MLCC)
Current and Thermal Limiting
Low Noise
Low Shutdown Current: 1 μA
3.0 V to 12 V Supply Range
–20°C to +85°C Ambient Temperature Range
Several Fixed Voltage Options
Ultrasmall SOT-23–5 Package
Excellent Line and Load Regulations

APPLICATIONS

Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
PCMCIA Regulator
Bar Code Scanners
Camcorders, Cameras

FUNCTIONAL BLOCK DIAGRAM



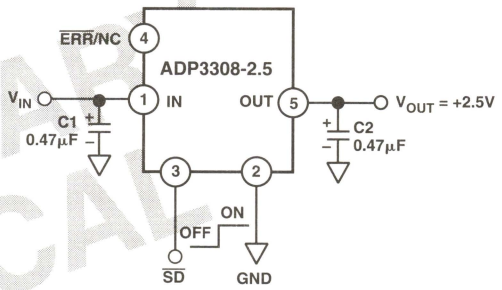


Figure 1. Typical Application Circuit

GENERAL DESCRIPTION

The ADP3308 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. It is pin-for-pin and functionally compatible with National's LP2980, but offers performance advantages. The ADP3308 stands out from the conventional LDOs with a novel architecture and an enhanced process. Its patented design requires only a 0.47 μF output capacitor for stability. This device is stable with any type of capacitor regardless of its ESR (Equivalent Serial Resistance) value, including ceramic types for space restricted applications. The ADP3308 achieves ±1.2% accuracy at room temperature and ±2.2% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3308 is only 100 mV (typical) at 50 mA. This device also includes a current limit and a shutdown feature. In shutdown mode, the ground current is reduced to ~1 μA.

The ADP3308 operates with a wide input voltage range from 3.0 V to 12 V and delivers a load current in excess of 100 mA. The ADP3308 anyCAP LDO offers a wide range of output voltages. For 100 mA version, refer to the ADP3309 data sheet.

anyCAP 100 mA Low Dropout Linear Regulator

ADP3309

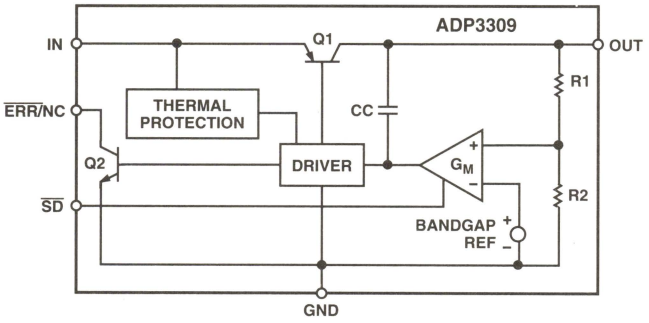
FEATURES

±1.2% Accuracy Over Line and Load Regulations @ 25°C
Ultralow Dropout Voltage: 160 mV Typical @ 100 mA
Requires Only C_O = 0.47 µF for Stability
anyCAP = Stable with All Types of Capacitors (Including MLCC)
Current and Thermal Limiting
Low Noise
Low Shutdown Current: 1 µA
3.0 V to 12 V Supply Range
–20°C to +85°C Ambient Temperature Range
Several Fixed Voltage Options
Ultrasmall SOT-23-5 Package
Excellent Line and Load Regulations

APPLICATIONS

Cellular Telephones
Notebook, Palmtop Computers
Battery Powered Systems
PCMCIA Regulator
Bar Code Scanners
Camcorders, Cameras

FUNCTIONAL BLOCK DIAGRAM



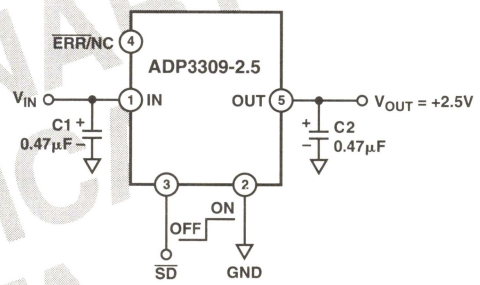


Figure 1. Typical Application Circuit

GENERAL DESCRIPTION

The ADP3309 is a member of the ADP330x family of precision low dropout anyCAP voltage regulators. It is pin-for-pin and functionally compatible with National's LP2981, but offers performance advantages. The ADP3309 stands out from conventional LDOs with a novel architecture and an enhanced process. Its patented design requires only a 0.47 µF output capacitor for stability. This device is stable with any type of capacitor regardless of its ESR (Equivalent Series Resistance) value, including ceramic types for space restricted applications. The ADP3309 achieves ±1.2% accuracy of at room temperature and ±2.2% overall accuracy over temperature, line and load regulations. The dropout voltage of the ADP3309 is only 160 mV (typical) at 100 mA. This device also includes a current limit and a shutdown feature. In shutdown mode, the ground current is reduced to ~1 µA.

The ADP3309 operates with a wide input voltage range from 3.0 V to 12 V and delivers a load current in excess of 100 mA. The ADP3309 anyCAP LDO offers a wide range of output voltages. For a 50 mA version, refer to the ADP3308 data sheet.

Precision Voltage Regulator Controller

ADP3310

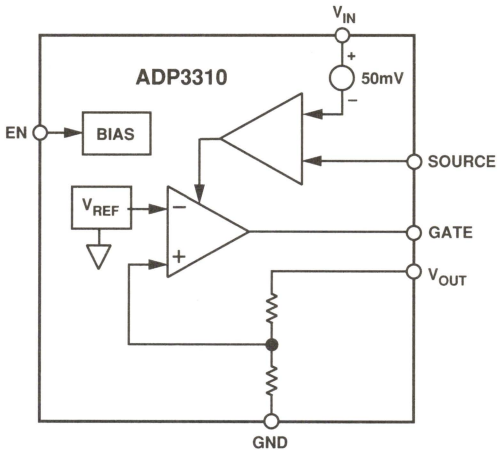
FEATURES

±1.5% Accuracy Over Line, Load and Temperature
Low Power BiCMOS: 800 μA Quiescent Current
Shutdown Current: 1 μA (Typical)
Stable with 10 μF Load Capacitor
+2.5 V to +15 V Operating Range
Fixed Output Voltage Options: 2.8 V, 3 V, 3.3 V, 5 V
Up to 10 A Output Current
SO-8 Package
–40°C to +85°C Ambient Temperature Range
Internal Gate to Source Protective Clamp
Current and Thermal Limiting
Programmable Current Limit
Foldback Current Limit

APPLICATIONS

Desktop Computers
Hand-Held Instruments
Cellular Telephones
Battery Operated Devices
Solar Powered Instruments
High Efficiency Linear Power Supplies
Battery Chargers

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADP3310 is a precision voltage regulator controller that can be used with an external Power PMOS device such as the NDP6020P to form a two chip low dropout linear regulator. The low quiescent current (800 μA) and the Enable feature make this device especially suitable for battery powered systems. The dropout voltage at 1 A is only 70 mV when used with the NDP6020P, allowing operation with minimal headroom and prolonging battery useful life. The ADP3310 can drive a wide range of currents, depending on the external PMOS device used.

Additional features of this device include: high accuracy (±1.5%) over line, load and temperature, gate-to-source voltage clamp to protect the external MOSFET and foldback current limit. A current limit threshold voltage of 50 mV (typ) allows 50 mΩ of board metal trace resistance to provide a 1 A current limit.

The ADP3310 operates from a wide input voltage range from 2.5 V to 15 V and is available in a small SO-8 package.

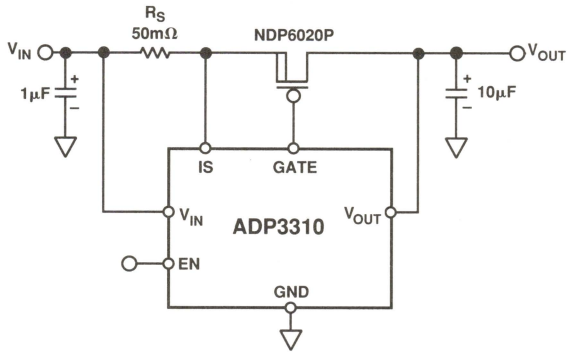


Figure 1. Typical Application Circuit

+5 V Fixed, Adjustable Low-Dropout Linear Voltage Regulator

ADP3367*

FEATURES

Low Dropout: 150 mV @ 200 mA
300 mV @ 300 mA
Low Power CMOS: 17 μA Quiescent Current
Shutdown Mode: 0.2 μA Quiescent Current
300 mA Output Current Guaranteed
Pin Compatible with MAX667
Stable with 10 μF Load Capacitor
+2.5 V to +16.5 V Operating Range
Low Battery Detector
Fixed +5 V or Adjustable Output
High Accuracy: ±2%
Dropout Detector Output
Low Thermal Resistance Package
ESD > 6000 V

APPLICATIONS

Handheld Instruments
Cellular Telephones
Battery Operated Devices
Portable Equipment
Solar Powered Instruments
High Efficiency Linear Power Supplies

GENERAL DESCRIPTION

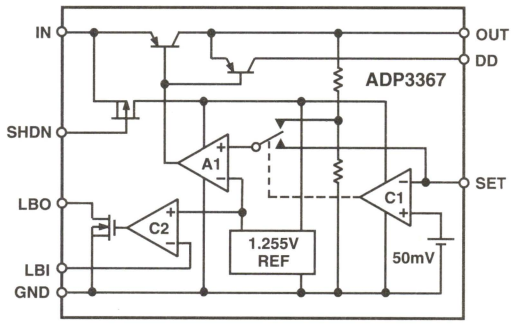
The ADP3367 is a low-dropout precision voltage regulator that can supply up to 300 mA output current. It can be used to give a fixed +5 V output with no additional external components or can be adjusted from +1.3 V to +16 V using two external resistors. Fixed or adjustable operation can be selected via the SET input. The low quiescent current (17 μA) in conjunction with the standby or shutdown mode (0.2 μA) makes this device especially suitable for battery powered systems. The dropout voltage when supplying 100 μA is only 15 mV allowing operation with minimal headroom thereby prolonging the useful battery life. At higher output current levels the dropout remains low increasing to just 150 mV when supplying 200 mA. A wide input voltage range from 2.5 V to 16.5 V is allowable. Additional features include a dropout detector and a low supply/battery monitoring comparator. The dropout detector can be used to signal loss of regulation while the low battery detector can be used to monitor the input supply voltage.

The ADP3367 is a much improved pin-compatible replacement for the MAX667. Improvements include lower supply current, tighter voltage accuracy and superior line and load regulation. Improved ESD protection (>6000 V) is achieved by advanced voltage clamping structures. The ADP3367 is specified over the industrial temperature range –40°C to +85°C and is available in narrow surface mount (SOIC) packages.

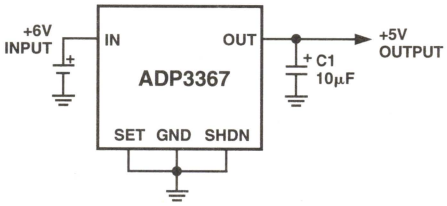
*Patent pending.

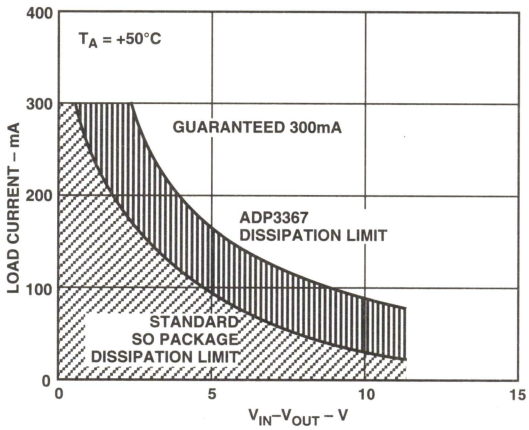
REV. 0

FUNCTIONAL BLOCK DIAGRAM



TYPICAL OPERATING CIRCUIT





Load Current vs. Input-Output Differential Voltage

ADI's proprietary Thermal Coastline leadframe used in ADP3367AR packaging, has 30% lower thermal resistance than the standard leadframes. This improvement in heat flow rate results in lower die temperature hence improves reliability.

POWER MANAGEMENT

Switching Regulators 3

SWITCHING REGULATORS

BUCK REGULATORS

- ADP1073
  V_{IN}: +30 V
  V_{OUT}: +5 V, +12 V, Adj.
  I_Q = 95 µA
- ADP1108
  V_{IN}: +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 90 µA
- ADP1110 ▶
  V_{IN}: +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 300 µA
- ADP1111
  V_{IN}: +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 300 µA
- ADP1173
  V_{IN}: +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 110 µA
- ADP3000
  V_{IN}: +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  400 kHz, I_Q = 500 µA

BOOST REGULATORS

- ADP1073
  V_{IN}: +1 V to +12.6 V
  V_{OUT}: +5 V, +12 V, Adj.
  I_Q = 95 µA
- ADP1108
  V_{IN}: +2 V to +12.6 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 90 µA
- **ADP1109A**/ADP1109
  V_{IN}: +2 V to +9/12 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 320 µA
- ADP1110
  V_{IN}: +1.15 V to +12.6 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 300 µA
- ADP1111
  V_{IN}: +2 V to 12.6 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 300 µA
- ADP1173
  V_{IN}: +2 V to 12.6 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 110 µA
- ADP3000
  V_{IN}: +2 V to 12.6 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  400 kHz, I_Q = 500 µA

BUCK/BOOST REGULATORS

- ADP1073
  V_{IN}: +1 V to +30 V
  V_{OUT}: +5 V, +12 V, Adj.
  I_Q = 95 µA
- ADP1108
  V_{IN}: +2 V to +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 90 µA
- ADP1110
  V_{IN}: +1 V to +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 300 µA
- ADP1111
  V_{IN}: +2 V to +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 300 µA
- ADP1173
  V_{IN}: +2 V to +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  I_Q = 110 µA
- ADP3000
  V_{IN}: +2 V to +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  400 kHz, I_Q = 500 µA

HIGH FREQUENCY REGULATORS

- ADP3000
  V_{IN}: +2 V to +30 V
  V_{OUT}: +3.3 V, +5 V, +12 V, Adj.
  400 kHz, I_Q = 500 µA
- ADP3050
  V_{IN}: +3.6 V to +30 V
  V_{OUT}: +3.3 V, +5 V, Adj.
  I_{OUT} = 1.2 A

HIGH EFFICIENCY CONTROLLERS

- ADP1147
  V_{IN}: +3.5 V to +20 V
  V_{OUT}: +3.3 V, +5 V
  I_Q = 10 µA
  Sleep Mode, +95% Eff.
- ADP1148
  V_{IN}: +3.5 V to +18 V
  V_{OUT}: +3.3 V, +5 V, Adj.
  I_Q = 10 µA
  Syn Switch w/ >95% Eff.

5-Bit Progammable Synchronous Pentium® Pro

- ▶ **ADP3152**
  V_{IN}: +5 V to +12 V
  V_{OUT}: Programmable
  +3.3 V to +5 V
- ADP3153
  ADP3152 with LDO
  Controller Output

Pentium is a registered trademark of Intel Corporation.

▶ = New Product since *1997 Short Form Designers' Guide.*

POWER MANAGEMENT

Switching Regulators:* DC-to-DC

Model	Input Voltage Volts	Output Voltage Options Volts	I_{OUT} mA	I_Q µA	Oscillator Frequency kHz	Control† Method	# Pins	Lowest Grade Price 1000s	Comments	Fax-code
Buck Regulators: Step-Down										
ADP1073	30	5, 12 Adj.	40	95	19	PST	8	$2.57		2015
ADP1108	30	3.3, 5, 12 Adj.	300	90	19	PST	8	$2.07		2017
ADP1110	30	3.3, 5, 12 Adj.	NS	300	70	PST	8	$2.57		2019
ADP1111	30	3.3, 5, 12 Adj.	200	110	72	PST	8	$2.07		2020
ADP1173	30	3.3, 5, 12 Adj.	100	110	24	PST	8	$2.07		2016
ADP3000	30	3.3, 5, 12 Adj.	180	500	400	PST	8	$2.46	77% Efficiency	2028
Boost Regulators: Step-Up										
ADP1073	1.15 to 12.6	5, 12 Adj.	10	95	19	PST	8	$2.57		2015
ADP1108	2 to 12.6	3.3, 5, 12 Adj.	150	90	19	PST	8	$2.07		2017
▶ **ADP1109**	**2 to 12**	**3.3, 5, 12 Adj.**	**100**	**320**	**120**	**PST**	**8**	**$2.07**		**2018**
▶ **ADP1109A**	**2 to 9**	**3.3, 5, 12 Adj.**	**100**	**320**	**120**	**PST**	**8**	**$2.07**		**2364**
ADP1110	1.15 to 12.6	3.3, 5, 12 Adj.	NS	300	70	PST	8	$2.57		2019
ADP1111	2 to 12.6	3.3, 5, 12 Adj.	100	110	72	PST	8	$2.07		2020
ADP1173	2 to 12.6	3.3, 5, 12 Adj.	80	110	24	PST	8	$2.07		2016
ADP3000	2 to 12.6	3.3, 5, 12 Adj.	100	500	400	PST	8	$2.46	80% Efficiency	2028
Buck/Boost Regulators: Step-Up or Step-Down										
ADP1073	1 to 30	5, 12 Adj.	10/40	95	19	PST	8	$2.57		2015
ADP1108	2 to 30	3.3, 5, 12 Adj.	150/300	90	19	PST	8	$2.07		2017
ADP1110	1.15 to 30	3.3, 5, 12 Adj.	NS	300	70	PST	8	$2.57		2019
ADP1111	2 to 30	3.3, 5, 12 Adj.	100/200	110	72	PST	8	$2.07		2020
ADP1173	2 to 30	3.3, 5, 12 Adj.	80/100	110	24	PST	8	$2.07		2016
ADP3000	2 to 30	3.3, 5, 12 Adj.	100/180	500	400	PST	8	$2.46	80% Efficiency	2028
High Frequency Regulators										
ADP3000	2 to 30	3.3, 5, 12 Adj.	100/180	500	400	PFM	8	$2.46	80% Efficiency	2028
ADP3050	**3.6 to 30**	**3.3, 5, Adj.**	**1.5A**	**1.5**	**300**	**PST**	**8**	**$TBD**	**On-Chip Switch, Step-Down**	**TBD**
High Frequency Controllers										
ADP1147	3.5 to 20	3.3, 5	5 mA–2A	1.6	250	PCT‡	8	$2.90	Step-Down Only, 97% Efficiency	2022
ADP1148	3.5, 5 Adj.	3.3, 5 Adj.	5 mA–2A	1.6	250	PCT‡	8	$3.31	98% Efficiency	2023
▶ **ADP3152**	**+5 to +12 V**	**1.3 to 3.5**	**14A**		**250**	**PCT‡**	**16**	**$TBD**	**5-Bit Programming**	**2422**
ADP3153	**+5 to +12 V**	**1.3 to 3.5**	**14A**		**250**	**PCT‡**	**18**	**$TBD**	**ADP3153 w/LDO Controller**	**TBD**

*All available with adjustable outputs. †PST = Pulse Skipping Technique = Periodic Pulse Width Modulater. ‡Control Method = Periodic Constant Off Time.
▶ = New Product since *1997 Short Form Designers' Guide*.

Micropower DC–DC Converter Adjustable and Fixed 3.3 V, 5 V, 12 V

ADP1073

FEATURES

Operates at Supply Voltages from 1.0 V to 30 V
Ground Current 100 μA
Works in Step-Up or Step-Down Mode
Very Few External Components Required
Low Battery Detector On-Chip
User-Adjustable Current Limit
Internal 1 A Power Switch
Fixed and Adjustable Output Voltage Versions
8-Lead DIP or SO-8 Package

APPLICATIONS

Single-Cell to 5 V Converters
Laptop and Palmtop Computers
Pagers
Cameras
Battery Backup Supplies
Cellular Telephones
Portable Instruments
4 mA–20 mA Loop Powered Instruments
Hand-Held Inventory Computers

GENERAL DESCRIPTION

The ADP1073 is part of a family of step-up/step-down switching regulators that operates from an input supply voltage of as little as 1.0 V. This extremely low input voltage allows the ADP1073 to be used in applications requiring use of a single cell battery as the primary power source.

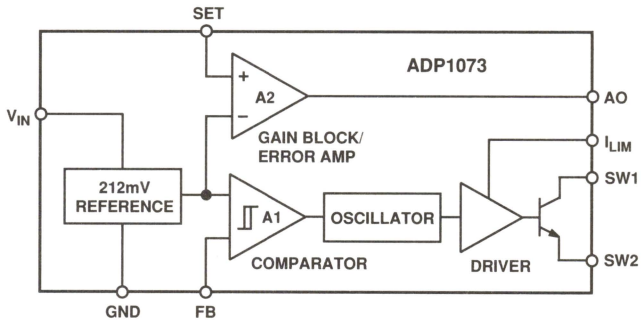
The ADP1073 can be configured to operate in either step-up or step-down mode but for input voltages greater than 3 V, the ADP1173 is recommended.

An auxiliary gain amplifier can serve as a low battery detector or linear regulator. Quiescent current on the ADP1073-5 is only 100 μA unloaded, making it ideal for systems where long battery life is required.

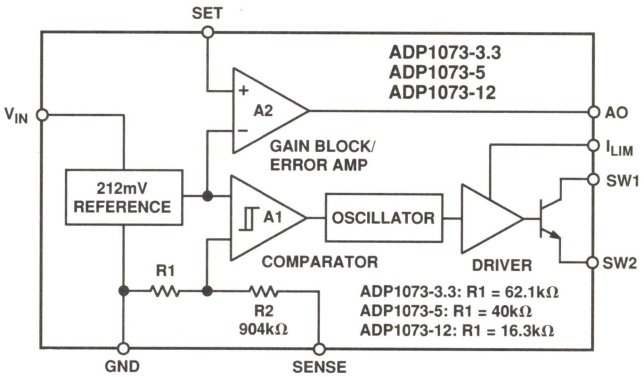
The ADP1073 can deliver 40 mA at 5 V from an input voltage range as low as 1.25 V, or 10 mA at 5 V from a 1.0 V input.

Current limiting is available by adding an external resistor.

FUNCTIONAL BLOCK DIAGRAMS



ADP1073



ADP1073-3.3, 5, 12

3

REV. 0

Micropower DC-DC Converter Adjustable and Fixed 3.3 V, 5 V, 12 V

ADP1108

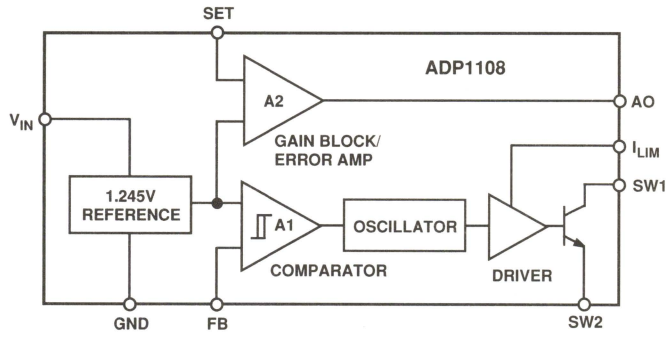
FEATURES

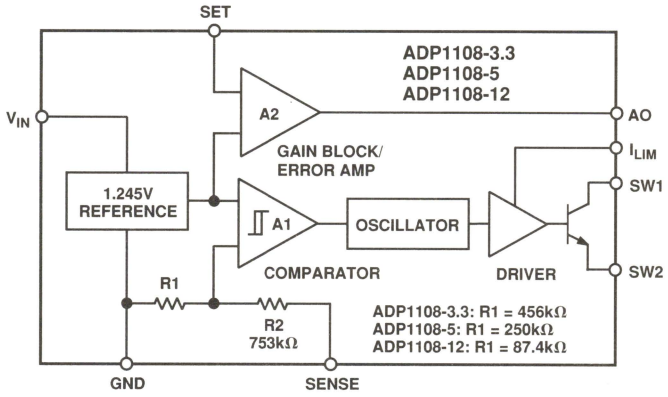
Operates at Supply Voltages From 2.0 V to 30 V
Consumes Only 110 μA Supply Current
Step-Up or Step-Down Mode Operation
Minimum External Components Required
Low Battery Detector Comparator On-Chip
User-Adjustable Current Limit
Internal 1 A Power Switch
Fixed or Adjustable Output Voltage Versions
8-Pin DIP or SO-8 Package

APPLICATIONS

Notebook/Palm Top Computers
3 V to 5 V, 5 V to 12 V Converters
9 V to 5 V, 12 V to 5 V Converters
LCD Bias Generators
Peripherals and Add-On Cards
Battery Backup Supplies
Cellular Telephones
Portable Instruments

FUNCTIONAL BLOCK DIAGRAMS





GENERAL DESCRIPTION

The ADP1108 is a highly versatile micropower switch-mode dc-dc converter that operates from an input voltage supply as low as 2.0 V and typically starts up from 1.8 V.

The ADP1108 can be programmed into a step-up or step-down dc-to-dc converter with only three external components. The fixed outputs are 3.3 V, 5 V and 12 V. An adjustable version is also available. In step-up mode, supply voltage range is 2.0 V to 12 V, and 30 V in step-down mode. The ADP1108 can deliver 150 mA at 5 V from a 2 AA cell input and 300 mA at 5 V from a 9 V input in step-down mode. Switch current limit can be programmed with a single resistor.

For battery operated and power conscious applications, the ADP1108 offers a very low power consumption of less than 110 μA.

The auxiliary gain block available in ADP1108 can be used as a low battery detector, linear post regulator, under voltage lockout circuit or error amplifier.

REV. 0

Micropower Low Cost Fixed 3.3 V, 5 V, 12 V and Adjustable DC-to-DC Converter

ADP1109

FEATURES

Operates at Supply Voltages 2 V to 12 V
Fixed 3.3 V, 5 V, 12 V and Adjustable Output
Minimum External Components Required
Ground Current: 320 μA
Oscillator Frequency: 120 kHz
Logic Shutdown
8-Lead DIP and SO-8 Packages

APPLICATIONS

Cellular Telephones
Single-Cell to 5 V Converters
Laptop and Palmtop Computers
Pagers
Cameras
Battery Backup Supplies
Portable Instruments
Laser Diode Drivers
Hand-Held Inventory Computers

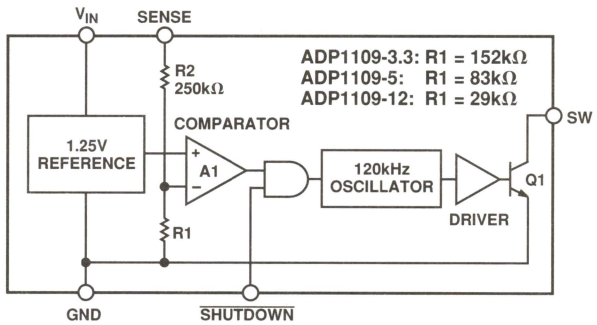
GENERAL DESCRIPTION

The ADP1109 is a versatile step-up switching regulator. The device requires only minimal external components to operate as a complete switching regulator.

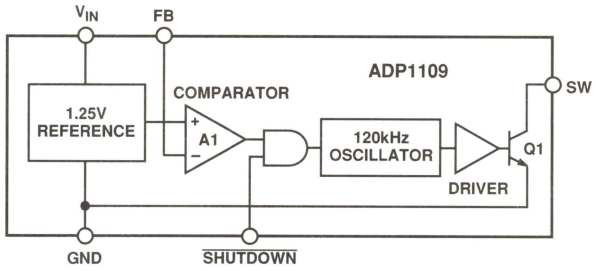
The ADP1109-5 can deliver 100 mA at 5 V from a 3 V input and the ADP1109-12 can deliver 60 mA at 12 V from a 5 V input. The device also features a logic controlled shutdown capability that, when a logic low is applied, will shut down the oscillator.

The 120 kHz operating frequency allows for the use of small surface mount components. The gated oscillator capability eliminates the need for frequency compensation.

FUNCTIONAL BLOCK DIAGRAMS

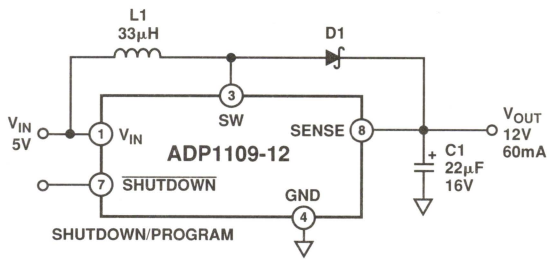


Fixed Output



Adjustable Output

TYPICAL APPLICATION



Flash Memory VPP Generator

REV. 0

Micropower Low Cost Fixed 3.3 V, 5 V, 12 V and Adjustable DC-to-DC Converter

ADP1109A

FEATURES

Operates at Supply Voltages 2 V to 9 V
Fixed 3.3 V, 5 V, 12 V and Adjustable Output
Minimum External Components Required
Ground Current: 460 μA
Oscillator Frequency: 120 kHz
Logic Shutdown
8-Lead DIP and SO-8 Packages

APPLICATIONS

Cellular Telephones
Single-Cell to 5 V Converters
Laptop and Palmtop Computers
Pagers
Cameras
Battery Backup Supplies
Portable Instruments
Laser Diode Drivers
Hand-Held Inventory Computers

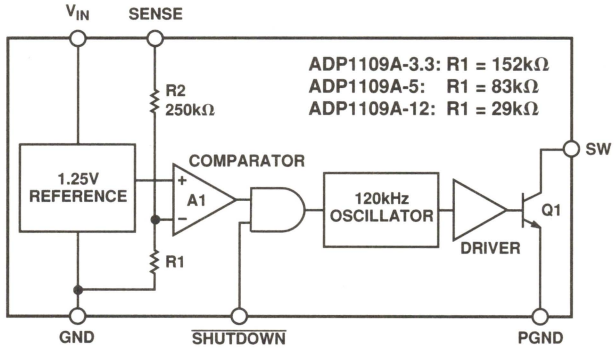
GENERAL DESCRIPTION

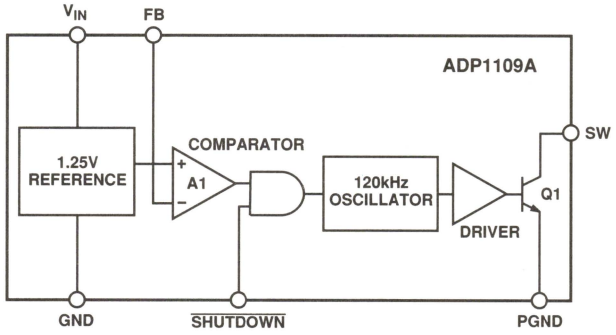
The ADP1109A is a versatile step-up switching regulator. The device requires only minimal external components to operate as a complete switching regulator.

The ADP1109A-5 can deliver 100 mA at 5 V from a 3 V input and the ADP1109A-12 can deliver 60 mA at 12 V from a 5 V input. The device also features a logic controlled shutdown capability that, when a logic low is applied, will shut down the oscillator. The 120 kHz operating frequency allows for the use of small surface mount components.

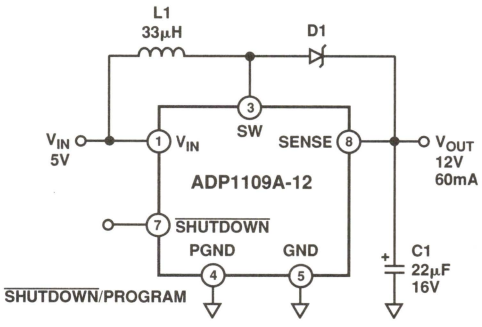
The gated oscillator capability eliminates the need for frequency compensation.

FUNCTIONAL BLOCK DIAGRAM





TYPICAL APPLICATION



Flash Memory VPP Generator

REV. 0

Micropower, Step-Up/Step-Down Switching Regulator; Adjustable and Fixed 3.3 V, 5 V, 12 V

ADP1110

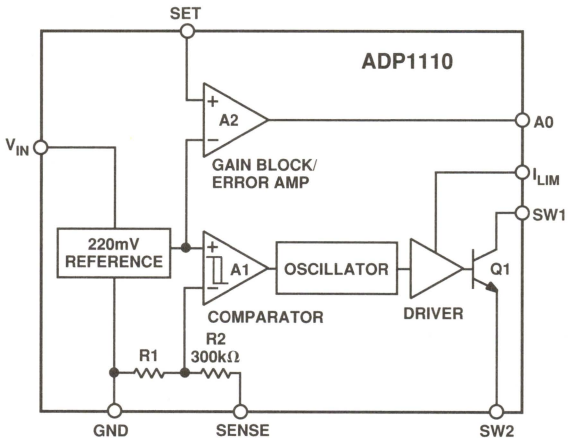
FEATURES

Operates at Supply Voltages From 1.0 V to 30 V
Step-Up or Step-Down Mode
Minimal External Components Required
Low-Battery Detector
User-Adjustable Current Limiting
Fixed or Adjustable Output Voltage Versions
8-Pin DIP or SO-8 Package

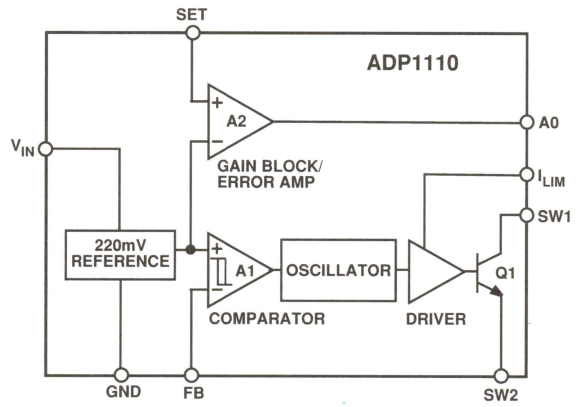
APPLICATIONS

Cellular Telephones
Single-Cell to 5 V Converters
Laptop and Palmtop Computers
Pagers
Cameras
Battery Backup Supplies
Portable Instruments
Laser Diode Drivers
Hand-Held Inventory Computers

FUNCTIONAL BLOCK DIAGRAMS



ADP1110 Block Diagram—Fixed Output Version



ADP1110 Block Diagram—Adjustable Output Version

GENERAL DESCRIPTION

The ADP1110 is part of a family of step-up/step-down switching regulators that operate from an input voltage supply as little as 1.0 V. This very low input voltage allows the ADP1110 to be used in applications that use a single cell as the primary power source.

The ADP1110 can be configured to operate in either step-up or step-down mode, but for input voltages greater than 3 V, the ADP1111 would be a more effective solution.

An auxiliary gain amplifier can serve as a low battery detector or as a linear regulator.

The quiescent current of 300 μA makes the ADP1110 useful in remote or battery powered applications.

The 70 kHz frequency operation also allows for the use of surface-mount external capacitors and inductors.

Battery protection circuitry limits the effect of reverse current to safe levels at reverse voltages up to 1.6 V.

Micropower, Step-Up/Step-Down SW Regulator; Adjustable and Fixed 3.3 V, 5 V, 12 V

ADP1111

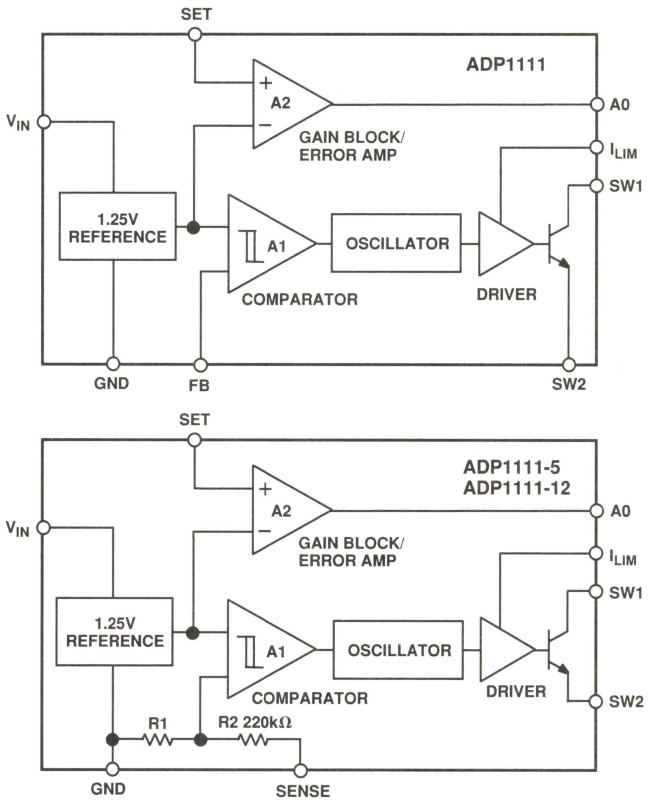
FEATURES

- Operates from 2 V to 30 V Input Voltage Range
- 72 kHz Frequency Operation
- Utilizes Surface Mount Inductors
- Very Few External Components Required
- Operates in Step-Up/Step-Down or Inverting Mode
- Low Battery Detector
- User Adjustable Current Limit
- Internal 1 A Power Switch
- Fixed or Adjustable Output Voltage
- 8-Pin DIP or SO-8 Package

APPLICATIONS

- 3 V to 5 V, 5 V to 12 V Step-Up Converters
- 9 V to 5 V, 12 V to 5 V Step-Down Converters
- Laptop and Palmtop Computers
- Cellular Telephones
- Flash Memory VPP Generators
- Remote Controls
- Peripherals and Add-On Cards
- Battery Backup Supplies
- Uninterruptible Supplies

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADP1111 is part of a family of step-up/step-down switching regulators that operates from an input voltage supply of 2 V to 12 V in step-up mode and up to 30 V in step-down mode. The ADP1111 can be programmed to operate in step-up/step-down or inverting applications with only 3 external components.

The fixed outputs are 3.3 V, 5 V and 12 V; and an adjustable version is also available. The ADP1111 can deliver 100 mA at 5 V from a 3 V input in step-up mode, or it can deliver 200 mA at 5 V from a 12 V input in step-down mode.

Maximum switch current can be programmed with a single resistor, and an open collector gain block can be arranged in multiple configuration for low battery detection, as a post linear regulator, undervoltage lockout, or as an error amplifier.

If input voltages are lower than 2 V, see the ADP1110.

REV. 0

ANALOG DEVICES

Micropower DC-DC Converter

ADP1173

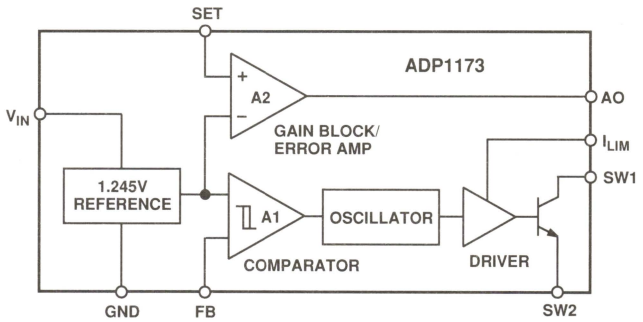
FEATURES

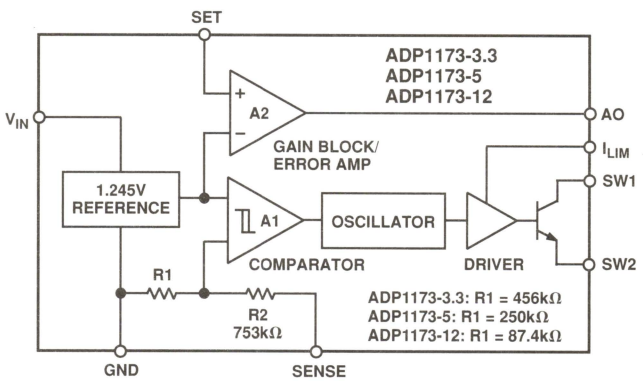
Operates From 2.0 V to 30 V Input Voltages
Only 110 μA Supply Current (Typical)
Step-Up or Step-Down Mode Operation
Very Few External Components Required
Low Battery Detector On-Chip
User-Adjustable Current Limit
Internal 1 A Power Switch
Fixed or Adjustable Output Voltage Versions
8-Pin DIP or SO-8 Package

APPLICATIONS

Notebook and Palmtop Computers
Cellular Telephones
Flash Memory V_{pp} Generators
3 V to 5 V, 5 V to 12 V Converters
9 V to 5 V, 12 V to 5 V Converters
Portable Instruments
LCD Bias Generators

FUNCTIONAL BLOCK DIAGRAMS





GENERAL DESCRIPTION

The ADP1173 is part of a family of step-up/step-down switching regulators that operates from an input supply voltage of as little as 2 V to 12 V in step-up mode and to 30 V in step-down mode.

The ADP1173 consumes as little as 110 μA in standby mode, making it ideal for applications that need low quiescent current. An auxiliary gain amplifier can serve as a low battery detector, linear regulator (under voltage lockout) or error amplifier.

The ADP1173 can deliver 80 mA at 5 V from a 3 V input in step-up configuration or 100 mA at 5 V from a 12 V input in step-down configuration. For input voltages of less than 2 V use the ADP1073.

REV. 0

High Efficiency Step-Down Switching Regulator Controllers

ADP1147-3.3/ADP1147-5

FEATURES

- Greater Than 95% Efficiency
- Current Mode Switching Architecture Provides Superior Load and Line Transient Response
- Wide Input Voltage Range 3.5 V* to 16 V
- User Defined Current Limit
- Short Circuit Protection
- Shutdown Pin
- Low Dropout Voltage
- Low Standby Current 160 μA typ
- Low Cost
- Available in 8-Lead PDIP or 8-Lead SOIC

APPLICATIONS

- Portable Computers
- Modems
- Cellular Telephones
- Portable Equipment
- GPS Systems
- Handheld Instruments

GENERAL DESCRIPTION

The ADP1147 is part of a family of High Efficiency Step-Down Switching Regulators. These regulators offer superior load and line transient response, a user defined current limit and an automatic power savings mode. The automatic power savings mode is used to maintain efficiency at lower output currents. The ADP1147 incorporates a constant off-time, current mode switching architecture to drive an external P-channel MOSFET at frequencies up to 250 kHz. Constant off-time switching generates a constant ripple current in the external inductor. This results in a wider input voltage operating range of 3.5 V* to 16 V, and a less complex circuit design.

*3.5 volt operation is for the ADP1147-3.3.

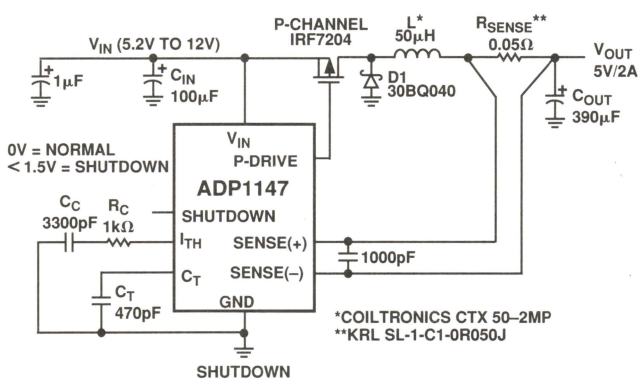
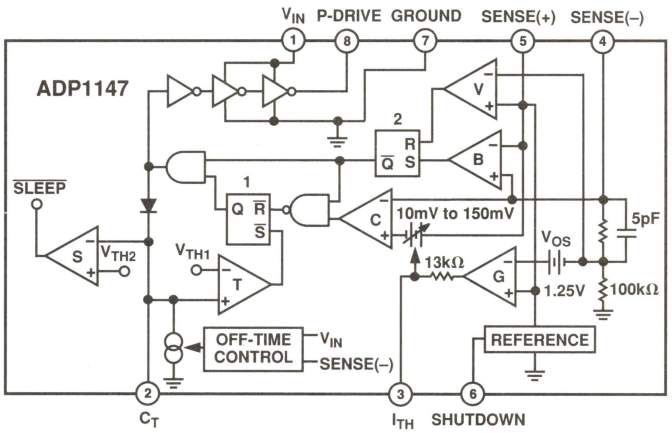


Figure 1. High Efficiency Step-Down Converter (Typical Application)

FUNCTIONAL BLOCK DIAGRAM



A very low dropout voltage with excellent output regulation can be obtained by minimizing the dc resistance of the Inductor, the R_{SENSE} resistor, and the $R_{DS(ON)}$ of the P-MOSFET. The power savings mode conserves power by reducing switching losses at lower output currents. When the output load current falls below the minimum required for the continuous mode the ADP1147 will automatically switch to the power savings mode. It will remain in this mode until the inductor requires additional current or the sleep mode is entered. In sleep mode with no load the standby power consumption of the device is reduced to 2.0 mW typical at V_{IN} = 10 V.

For designs requiring even greater efficiencies refer to the ADP1148 data sheet.

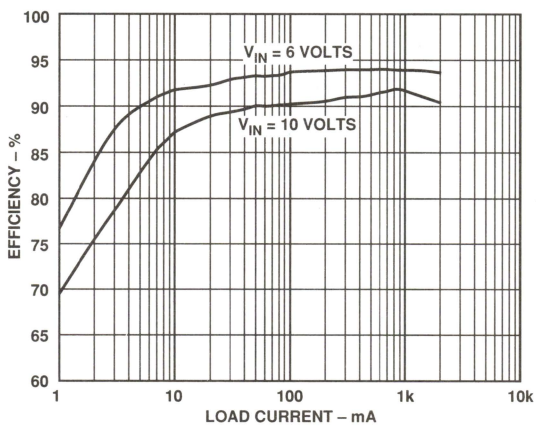


Figure 2. ADP1147-5 Typical Efficiency, Figure 1 Circuit

REV. 0

High Efficiency Synchronous Step-Down Switching Regulators

ADP1148, ADP1148-3.3/ADP1148-5

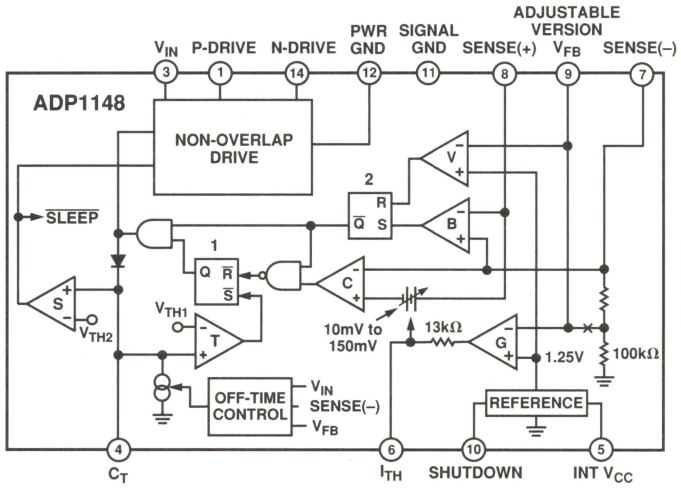
FEATURES

- Operation From 3.5 V to 18 V Input Voltage
- Ultrahigh Efficiency > 95%
- Low Shutdown Current
- Current Mode Operation for Excellent Line and Load Transient Response
- High Efficiency Maintained Over Wide Current Range
- Logic Controlled Micropower Shutdown
- Short Circuit Protection
- Very Low Dropout Operation
- Synchronous FET Switching for High Efficiency
- Adaptive Nonoverlap Gate Drives

APPLICATIONS

- Notebook and Palmtop Computers
- Portable Instruments
- Battery Operated Digital Devices
- Industrial Power Distribution
- Avionics Systems
- Telecom Power Supplies
- GPS Systems
- Cellular Telephones

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADP1148 is part of a family of synchronous step-down switching regulator controllers featuring automatic sleep mode to maintain high efficiencies at low output currents. These devices drive external complementary power MOSFETs at switching frequencies up to 250 kHz using a constant off-time current-mode architecture.

The constant off-time architecture maintains constant ripple current in the inductor, easing the design of wide input range converters. Current-mode operation provides excellent line and load transient response. The operating current level is user programmable via an external current sense resistor.

The ADP1148 incorporates automatic Power Saving Sleep Mode operation when load currents drop below the level required for continuous operation. In sleep mode, standby power is reduced to only about 2 mW at V_{IN} = 10 V. In shutdown, both MOSFETs are turned off.

TYPICAL APPLICATIONS

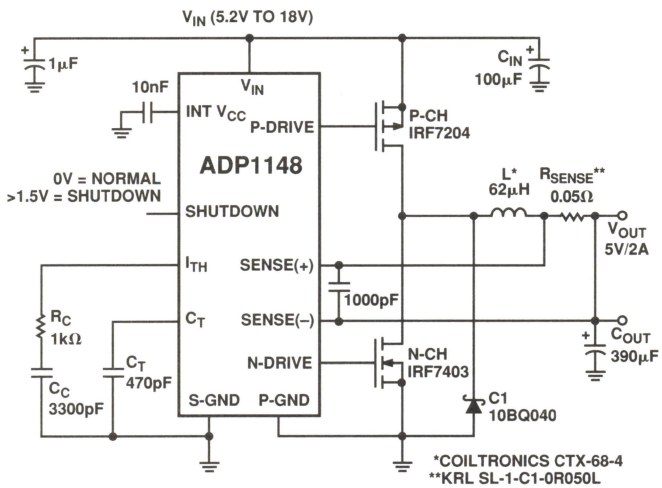


Figure 1. High Efficiency Step-Down Converter

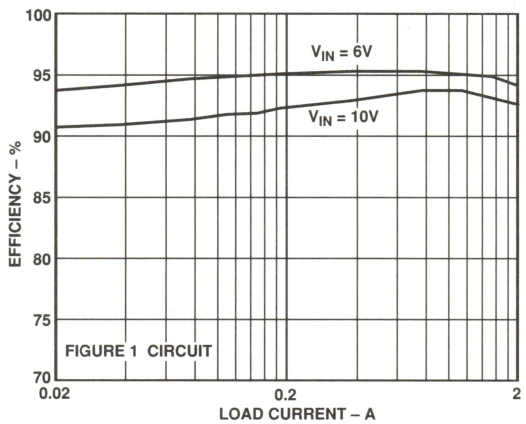


Figure 2. ADP1148-5 Typical Efficiency

REV. 0

Micropower Step-Up/Step-Down Fixed 3.3 V, 5 V, 12 V and Adjustable High Frequency Switching Regulator

ADP3000

FEATURES

Operates at Supply Voltages from 2 V to 30 V
Works in Step-Up or Step-Down Mode
Very Few External Components Required
High Frequency Operation Up to 400 kHz
Low Battery Detector on Chip
User Adjustable Current Limit
Fixed and Adjustable Output Voltage
8-Pin DIP and SO-8 Package
Small Inductors and Capacitors

APPLICATIONS

Notebook, Palmtop Computers
Cellular Telephones
Hard Disk Drives
Portable Instruments
Pagers

GENERAL DESCRIPTION

The ADP3000 is a versatile step-up/step-down switching regulator that operates from an input supply voltage of 2 V to 12 V in step-up mode and up to 30 V in step-down mode.

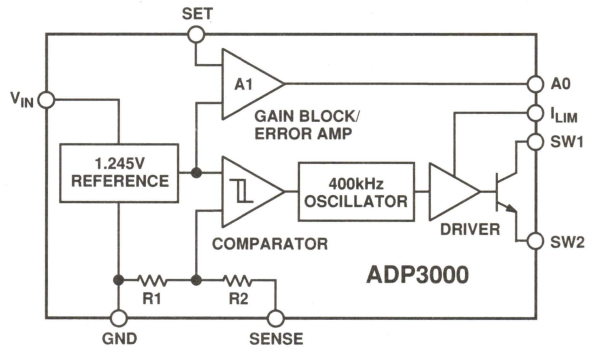
The ADP3000 operates in Pulse Frequency Mode (PFM) and consumes only 500 µA, making it highly suitable for applications that require low quiescent current.

The ADP3000 can deliver an output current of 100 mA at 3 V from a 5 V input in step-down configuration and 180 mA at 3.3 V from a 2 V input in step-up configuration.

The auxiliary gain amplifier can be used as a low battery detector, linear regulator undervoltage lockout or error amplifier.

The ADP3000 operates at 400 kHz switching frequency. This allows the use of small external components (inductors and capacitors), making the device very suitable for space constrained designs.

FUNCTIONAL BLOCK DIAGRAMS



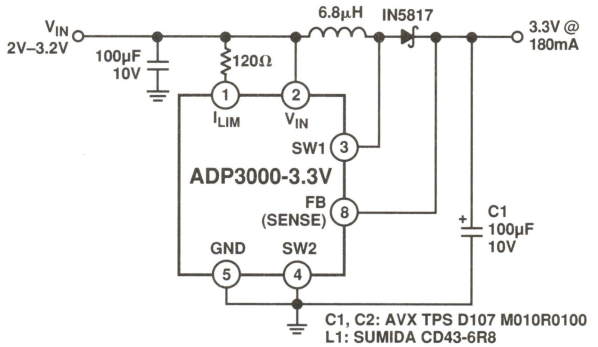


Figure 1. Typical Application

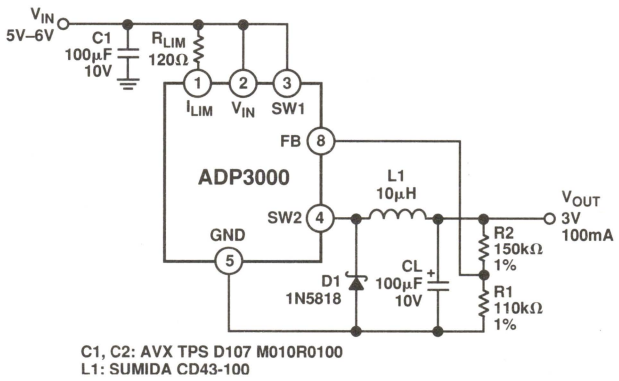


Figure 2. Step-Down Mode Operation

REV. 0

300 kHz, 1.5 A Step-Down Switching Regulator

ADP3050

FEATURES
Wide Input Voltage Range: 3.6 V to 30 V
3.3 V, 5 V and Adjustable Output Versions
0.4 Ω Saturating Switch
High Switching Frequency 300 kHz
Uses Small Surface-Mount Components
Cycle-by-Cycle Current Limiting

APPLICATIONS
Battery Powered Systems
Portable Computers
Battery Chargers
Distributed Power

GENERAL DESCRIPTION

The ADP3050 is a current-mode monolithic buck (step-down) switching regulator that contains a 1.5 A switch and all control, logic and protection functions. It uses a unique compensation scheme which allows the use of any type of output capacitor (tantalum, ceramic, electrolytic, OSCON). Unlike with some buck regulators, the design is not restricted to using a specific type of output capacitor or ESR value.

A special boosted drive stage is used to saturate the NPN power switch, providing a system efficiency higher than conventional bipolar buck switchers. Further efficiency improvements are obtained by using the low voltage regulated output to provide the device's internal operating current. A high switching frequency allows the use of small external surface-mount components. A wide variety of standard off-the-shelf devices can be used, providing a great deal of design flexibility. A complete regulator design requires only a few external devices.

A shutdown signal will place the device in a low-power mode, reducing the supply current to under 15 μA. Internal protection features include thermal shutdown circuitry and a cycle-by-cycle foldback current-limit for the power switch to provide complete device protection under fault conditions.

The ADP3050 provides excellent line and load regulation, maintaining ±2.5% output voltage accuracy over temperature and under all input voltage and output current conditions. These devices are available in 3.3 V, 5 V and adjustable output versions, in both the 8-pin DIP and SOIC packages.

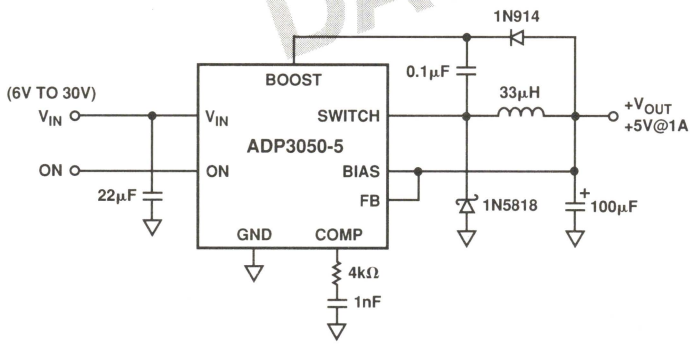


Figure 1. Typical Application

REV. 0

5-Bit Programmable Synchronous Switching Regulator Controller For Pentium II Processor

ADP3152

FEATURES

5-Bit Digitally Programmable 1.8 V to 3.5 V Output Voltage
Dual N-Channel Synchronous Driver
Initial Output Accuracy ±1% (0°C to 70°C)
High Efficiency
Current-Mode Operation
Short Circuit Protection
Power Good Output
Integrated Over Voltage Protection Crowbar
16-Lead SOIC Package
VRM 8.2 Compatible

APPLICATIONS

Desktop PC Power Supply for:
Pentium II Processor
Pentium Pro Processor
Pentium Processor
AMD–K6 Processor
VRM Modules

GENERAL DESCRIPTION

The ADP3152 is a highly efficient synchronous switching regulator controller optimized for Pentium II Processor applications where 5 V is stepped down to a digitally controlled output voltage between 1.8 V and 3.5 V. Using a 5-bit DAC to read a voltage identification (VID) code directly from the processor, the ADP3152 uses a current mode constant off-time architecture to generate its precise output voltage.

The ADP3152 drives two N-channel MOSFETS in a synchronous rectified buck converter, at a maximum switching frequency of 250 kHz. Using the recommended loop compensation and guidelines, the ADP3152 provides a dc/dc converter that meets Intel's stringent transient specifications with a minimum number of output capacitors and smallest footprint. Additionally, the current mode architecture also provides guaranteed short circuit protection and adjustable current limiting.

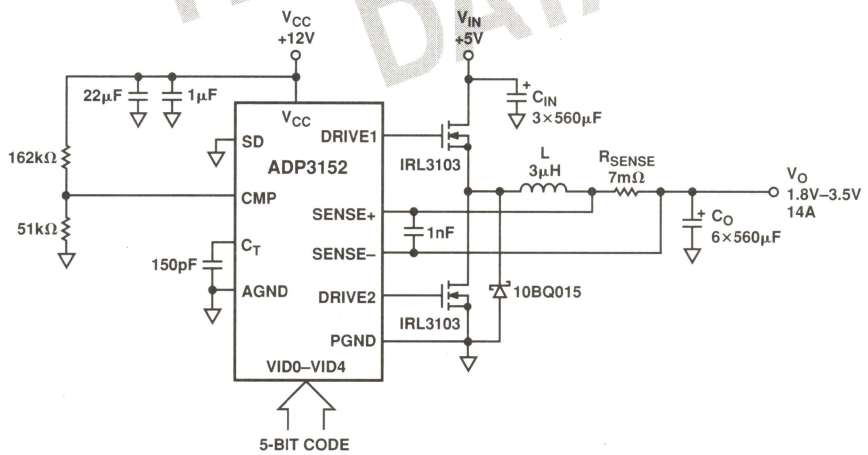


Figure 1. Typical Application

REV. 0

5-Bit Programmable Dual Power Supply Controller For Pentium II Processor

ADP3153

FEATURES

- 5-Bit Digitally Programmable 1.3 V to 3.5 V Output Voltage
- Dual N-channel Synchronous Driver
- Output Accuracy ±1.5% (0°C to +70°C)
- High Efficiency
- Current Mode Operation
- Short Circuit Protection
- Power Good Output
- Overvoltage Protection Crowbar
- 18-Lead SOIC Package
- Onboard Linear Regulator Controller

APPLICATIONS

- Desktop PC Power Supply For:
  - Pentium II Processor
  - Pentium Pro Processor
  - Pentium Processor
  - AMD-K6 Processor
- VRM Modules

GENERAL DESCRIPTION

The ADP3153 contains an efficient synchronous switching regulator controller and a linear regulator controller. The switching regulator controller is optimized for Pentium Pro and Pentium II Processor applications where 5 V is stepped down to a digitally controlled output voltage between 1.3 V and 3.5 V. Using a 5-bit DAC to read a voltage identification (VID) code directly from the processor, the ADP3153 generates the precise output voltage by using a current mode constant off-time architecture to drive two synchronous N-channel MOSFETS at a switching frequency of 250 kHz. The constant off-time architecture maintains constant inductor ripple current while current mode operation provides excellent line and load transient response. In addition, the operating current level is user programmable with an external current sense resistor.

The ADP3153's linear regulator controller drives an external N-channel device. The output voltage is set by the ratio of the external feedback resistors. The controller has been designed for excellent load transient response.

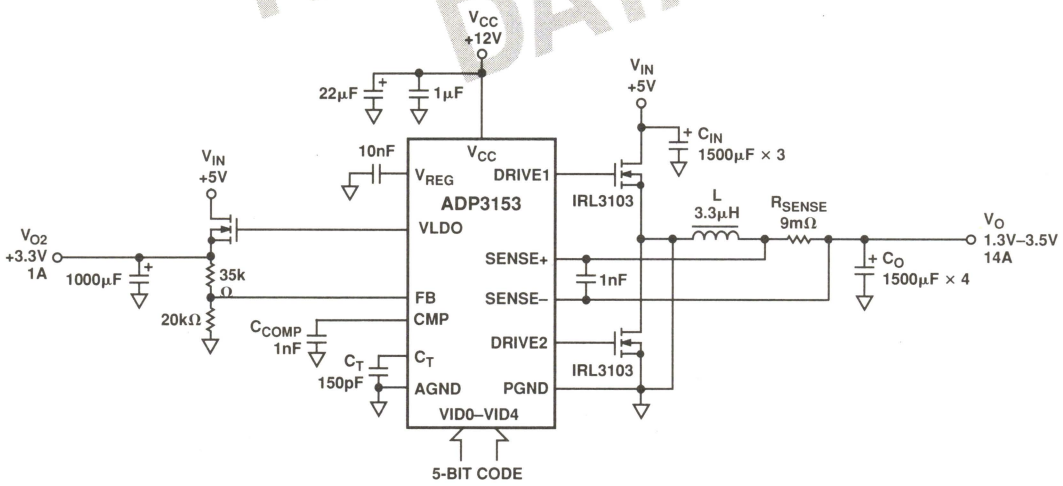


Figure 1. Typical Application

REV. 0

POWER MANAGEMENT

Switched Capacitor Voltage Converters

Switched Capacitor Voltage Converters

Unregulated Voltage Inverters

- ADM660
  - V_{OUT}: –1.5 V to –7 V
  - I_{OUT}: 50 mA w/ +90% Eff.
- ADM8660
  - V_{OUT}: +11.5 V to –7 V
  - I_{OUT}: 100 mA
  - Shutdown Mode
- ADP3603
  - V_{OUT}: –1.2 V to –4.0 V
  - I_{OUT} MAX: 50 mA
  - F_{SWITCH} is 120 kHz
- ADP3604
  - V_{OUT}: –1.3 V to –4.0 V
  - I_{OUT} MAX: 120 mA
  - F_{SWITCH} is 120 kHz
- ADP3605
  - V_{OUT}: –1.2 V to –4.0 V
  - I_{OUT} MAX: 120 mA
  - F_{SWITCH} is 250 kHz

Regulated Voltage Inverters

- ADP3603
  - V_{OUT}: –3.0 V
  - I_{OUT} MAX: 50 mA
  - F_{SWITCH} is 120 kHz
- ADP3604
  - V_{OUT}: –3.0 V
  - I_{OUT} MAX: 120 mA
  - F_{SWITCH} is 120 kHz

Boost Converters

- ADM660
  - V_{IN}: +1.5 V to +7 V
  - V_{OUT}: 2 × V_{IN}
  - I_{OUT} = 100 mA
- ADP3607
  - V_{IN}: +3 V to +5 V
  - Regulated Output +5V
  - I_{OUT} = 50 mA

POWER MANAGEMENT

Switched Capacitor Voltage Converters: DC-to-DC

Model	V dc Input Volts	Oscillator Frequency kHz	V_{OUT} Volts	I_{OUT} mA	I_Q mA	With Shut-Down	# Pins	Lowest Grade Price 100s	Comments	Fax-code
Unregulated Voltage Inverters										
ADM660	+1.5 to +7	25 or 120	–1.5 to –7	100	0.6	No	8	$1.90	Freq. Set by Ext. Capacitor	1934
ADM8660	+1.5 to +7	25 or 120	–1.5 to –7	100	0.6	Yes	8	$2.00	With Shutdown	1934
ADP3603	+4.5 to +6	240	–1.2 to –4	50	2.4	Yes	8	$2.00	±3% Accuracy @ –3 V Output	1982
ADP3604	+4.5 to +6	240	–1.2 to –4	120	2.9	Yes	8	$2.50	±3% Accuracy @ –3 V Output	2051
ADP3605	**+4.5 to +6**	**500**	**–1.2 to –4**	**120**	**2**	**Yes**	**8**	**$2.00**	**±2% Accuracy @ –3 V Output**	**2198**
Regulated Voltage Inverters										
ADP3603	+4.5 to +6	240	–3 ±3%	50	2.4	Yes	8	$2.00	Output Ohms/Ripple = 12 Ω/25 mV	1982
ADP3604	+4.5 to +6	240	–3 ±3%	120	2.9	Yes	8	$2.50	Output Ohms/Ripple = 8 Ω/25 mV	2051
ADP3605	**+4.5 to +6**	**500**	**–3 ±2%**	**120**	**2**	**Yes**	**8**	**$2.00**	**With Shutdown**	**2198**
Boost Converters										
ADM660	+2.5 to +7	25 or 120	+5 to +14	100	0.6	No	8	$1.90	Voltage Doubler Configuration	1934
ADP3607	**+3 to +6**	**500**	**+5**	**50**	**2**	**Yes**	**8**	**$2.30**	**Regulated V_{OUT}, with Shutdown**	**2199**

CMOS Switched-Capacitor Voltage Converters

ADM660/ADM8660

FEATURES

ADM660: Inverts or Doubles Input Supply Voltage
ADM8660: Inverts Input Supply Voltage
100 mA Output Current
Shutdown Function (ADM8660)
2.2 μF or 10 μF Capacitors
0.3 V Drop at 30 mA Load
+1.5 V to +7 V Supply
Low Power CMOS: 600 μA Quiescent Current
Selectable Charge Pump Frequency (25 kHz/120 kHz)
Pin Compatible Upgrade for MAX660, MAX665, ICL7660
Available in 16-Lead TSSOP Package

APPLICATIONS

Handheld Instruments
Portable Computers
Remote Data Acquisition
Op Amp Power Supplies

GENERAL DESCRIPTION

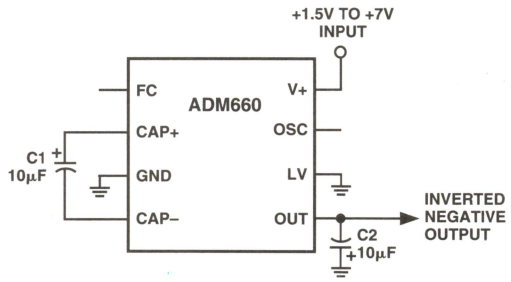
The ADM660/ADM8660 is a charge-pump voltage converter that can be used to either invert the input supply voltage giving $V_{OUT} = -V_{IN}$ or double it (ADM660 only) giving $V_{OUT} = 2 \times V_{IN}$.

Input voltages ranging from +1.5 V to +7 V can be inverted into a negative –1.5 V to –7 V output supply. This inverting scheme is ideal for generating a negative rail in single power supply systems. Only two small external capacitors are needed for the charge pump. Output currents up to 50 mA with greater than 90% efficiency are achievable, while 100 mA achieves greater than 80% efficiency.

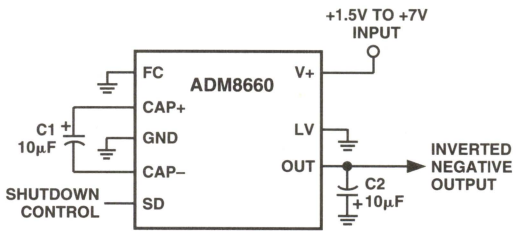
A Frequency Control (FC) input pin is used to select either 25 kHz or 120 kHz charge-pump operation. This is used to optimize capacitor size and quiescent current. With 25 kHz selected, a 10 μF external capacitor is suitable, while with 120 kHz the capacitor may be reduced to 2.2 μF. The oscillator frequency on the ADM660 can also be controlled with an external capacitor connected to the OSC input or by driving this input with an external clock. In applications where a higher supply voltage is desired it is possible to use the ADM660 to double the input voltage. With input voltages from 2.5 V to 7 V, output voltages from 5 V to 14 V are achievable with up to 100 mA output current.

The ADM8660 features a low power shutdown (SD) pin instead of the external oscillator (OSC) pin. This can be used to disable the device and reduce the quiescent current to 300 nA.

TYPICAL CIRCUIT CONFIGURATIONS



Voltage Inverter Configuration (ADM660)



Voltage Inverter Configuration with Shutdown (ADM8660)

The ADM660 is a pin compatible upgrade for the MAX660, MAX665, ICL7660 and LTC1046.

The ADM660/ADM8660 is available in 8-pin DIP and narrow-body SOIC. The ADM660 is also available in a 16-lead TSSOP package.

ADM660/ADM8660 Options

Option	ADM660	ADM8660
Inverting Mode	Y	Y
Doubling Mode	Y	N
External Oscillator	Y	N
Shutdown	N	Y
Package Options		
SO-8	Y	Y
N-8	Y	Y
RU-16	Y	N

REV. A

Switched Capacitor Voltage Converter with Regulated Output

ADP3603*

FEATURES

- Fully Regulated Output
- High Output Current: 50 mA
  - 120 mA Version (ADP3604) Is Also Available
- Outstanding Precision: ±3% Output Accuracy
- Input Voltage Range: +4.5 V to +6.0 V
- Output Voltage: –3.0 V (Regulated)
- High Switching Frequency: 120 kHz (240 kHz Internal Oscillator)
- Shutdown Capability
- Small Outline 8-Pin SOIC Package

APPLICATIONS

- Voltage Inverters
- Negative Voltage Regulators
- Computer Peripherals and Add-On Cards
- Portable Instruments
- Battery Powered Devices
- Pagers and Radio Control Receivers
- Disk Drives
- Mobile Phones

GENERAL DESCRIPTION

The ADP3603 switched capacitor voltage converter provides a regulated output voltage with minimum voltage loss and requires a minimum number of external components. In addition, the ADP3603 does not require the use of an inductor. The ADP3603 provides up to 50 mA of output current with ±3% output accuracy.

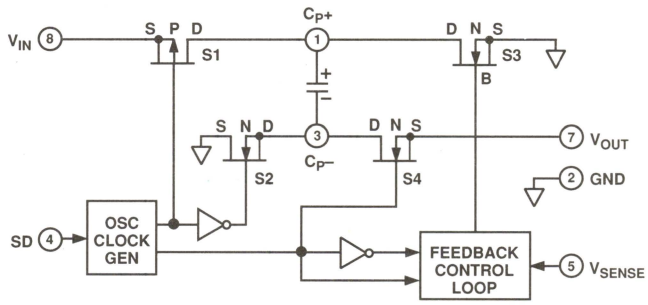
The internal oscillator runs at 240 kHz nominal frequency which produces an output switching frequency of 120 kHz, allowing the use of small charge pump and filter capacitors.

The ADP3603 is primarily designed for use as a high frequency negative voltage regulator/inverter. The output voltages of the ADP3603 can range from –1.2 V to –4.0 V, nominally –3.0 V. For other output voltages, contact the factory.

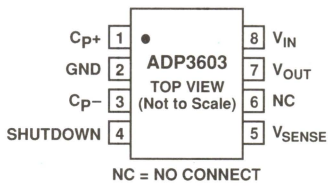
The ADP3603 dissipates less than 150 mW of power and features fast shutdown mode capability (<5 ms) that also drops the quiescent current to 1.4 mA (typ). For a higher output current (120 mA) version, see the ADP3604.

*Patent pending.

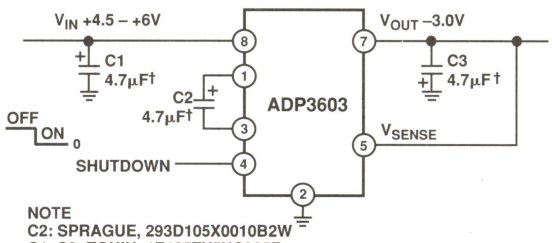
FUNCTIONAL BLOCK DIAGRAM



PIN CONFIGURATION
8-Pin SOIC
(SO-8)



NC = NO CONNECT



NOTE
C2: SPRAGUE, 293D105X0010B2W
C1, C3: TOKIN, 1E105ZY5UC205F
†FOR BEST PERFORMANCE 10µF IS RECOMMENDED

Figure 1. Typical Application Circuit

REV. 0

Switched Capacitor Voltage Converter with Regulated Output

ADP3604*

FEATURES

- Fully Regulated Output
- High Output Current: 120 mA
  - 50 mA Version (ADP3603) Is Also Available
- Outstanding Precision: ±3% Output Accuracy
- Input Voltage Range: +4.5 V to +6.0 V
- Output Voltage: –3.0 V (Regulated)
- High Switching Frequency: 120 kHz (240 kHz Internal Oscillator)
- Shutdown Capability
- Small Outline 8-Pin SOIC Package

APPLICATIONS

- Voltage Inverters
- Voltage Regulators
- Computer Peripherals and Add-On Cards
- Portable Instruments
- Battery Powered Devices
- Pagers and Radio Control Receivers
- Disk Drives
- Mobile Phones

GENERAL DESCRIPTION

The ADP3604 switched capacitor voltage converter provides a regulated output voltage with minimum voltage loss and requires a minimum number of external components. In addition, the ADP3604 does not require the use of an inductor. The ADP3604 provides up to 120 mA of output current with ±3% output accuracy.

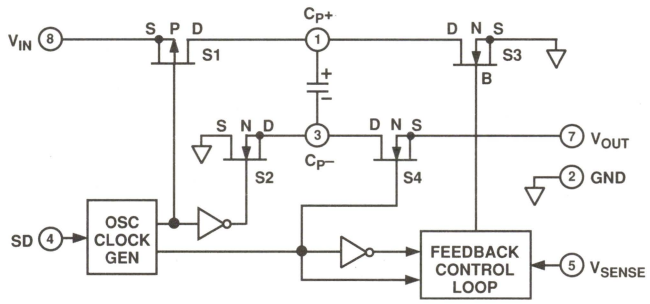
The internal oscillator runs at 240 kHz nominal frequency which produces an output switching frequency of 120 kHz, allowing the use of small charge pump and filter capacitors.

The ADP3604 is primarily designed for use as a high frequency negative voltage regulator/inverter. The output voltages of the ADP3604 can range from –1.2 V to –4.0 V, nominally –3.0 V. For other output voltages, contact the factory.

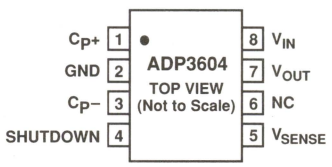
The ADP3604 dissipates less than 350 mW of power and features fast shutdown mode capability (<5 ms) that also drops the quiescent current to 1.5 mA (typ). For a lower cost, 50 mA output current version, see the ADP3603.

*Patent pending.

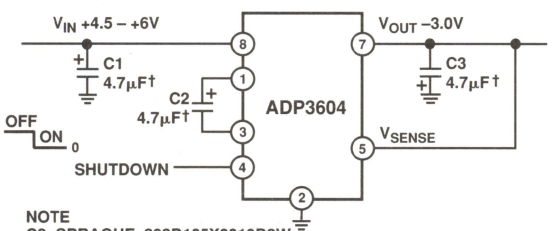
FUNCTIONAL BLOCK DIAGRAMS



PIN CONFIGURATION
8-Pin SOIC
(SO-8)



NC = NO CONNECT



NOTE
C2: SPRAGUE, 293D105X0010B2W
C1, C3: TOKIN, 1E105ZY5UC205F
†FOR BEST PERFORMANCE 10µF IS RECOMMENDED

Figure 1. Typical Application Circuit

REV. 0

120 mA Switched Capacitor Voltage Inverter with Regulated Output

ADP3605

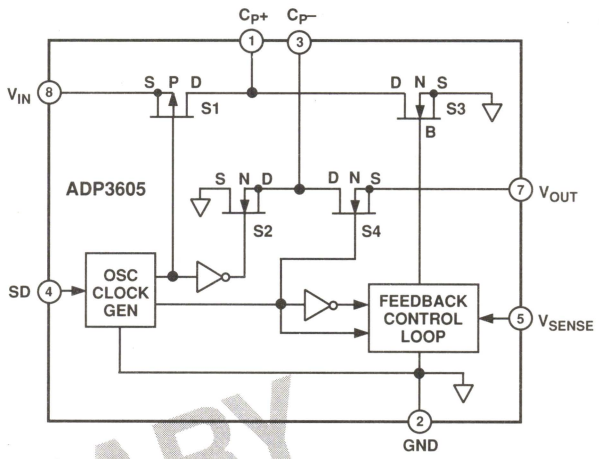
FEATURES

Fully Regulated Output Voltage
High Output Current: 120 mA
Outstanding Output Accuracy Over Line, Load and Temperature: ±3%
High Switching Frequency: 250 kHz (500 kHz Internal)
Low Shutdown Current
Input Voltage Range from 3 V to 6 V
SO-8 and TSSOP-14 Packages
–40°C to +85°C Ambient Temperature Range

APPLICATIONS

Voltage Inverters
Voltage Regulators
Computer Peripherals and Add-On Cards
Portable Instruments
Battery Powered Devices
Pagers and Radio Control Receivers
Disk Drives
Mobile Phones

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADP3605 is a 120 mA regulated output voltage switched capacitor voltage inverter. It does not require an inductor and operates at 250 kHz switching frequency (500 kHz internal), allowing the use of small charge pump and filter capacitors. The ADP3605 requires only one pump capacitor and an output bypass capacitor. With just a few capacitors, the entire circuit is completely surface-mountable.

The ADP3605 is pin-for-pin and functionally compatible with the ADP3604, but offers more performance advantages than previously available. The ADP3605 provides higher accuracy (±3%) over line, load and temperature, lower shutdown current (2 μA typ), and the use of small capacitors as a result of the fast switching frequency.

This switched capacitor voltage inverter family offers the ADP3605-3 in a fixed –3 V output, as well as the ADP3605 in an adjustable output. The ADP3605 adjustable output voltage device can be programmed with an external resistor to provide the same high accuracy as the ADP3605-3.

The ADP3605-3 and ADP3605 operate from a single positive input as low as 3 V.

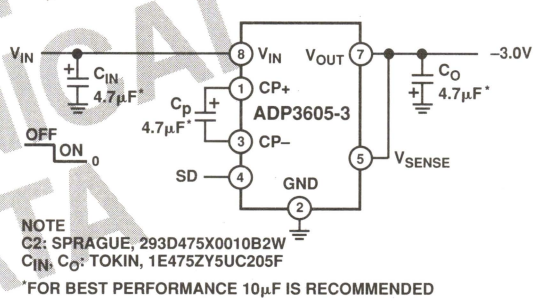


Figure 1. Typical Application Circuit

REV. 0

50 mA Switched Capacitor Voltage Boost with Regulated Output

ADP3607

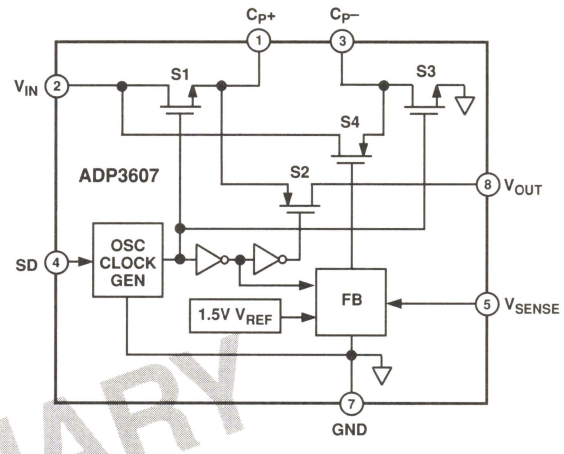
FEATURES

Fully Regulated Output Voltage
Input Voltage Range from 3 V to 5 V
50 mA Output Current
Outstanding Output Accuracy Over Line, Load and Temperature: ±2%
High Switching Frequency: 250 kHz (500 kHz Internal)
Low Shutdown Current
SO-8 Package
–40°C to +85°C Ambient Temperature Range

APPLICATIONS

Voltage Regulators
Computer Peripherals and Add-On Cards
Portable Instruments
Battery Powered Devices
Pagers and Radio Control Receivers
Disk Drives
Mobile Phones

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADP3607 is a 50 mA regulated output voltage switched capacitor voltage converter. It does not require an inductor and operates at 250 kHz switching frequency from an internal 500 kHz oscillator, allowing the use of small charge pump and filter capacitors.

Systems no longer have to compromise accuracy and efficiency to accommodate limited board space with the ADP3607. The device combines the benefits of outstanding accuracy (±2%) over line, load and temperature, low shutdown current (10 µA) and the use of small capacitors as a result of the fast switching frequency into one chip.

This switched capacitor voltage converter family offers a fixed 5 V output as well as an adjustable output. The ADP3607 is an adjustable output voltage device that can be programmed with an external resistor to provide the same high accuracy.

The ADP3607-5 and ADP3607 operate from a single input as low as 3 V and dissipates less than 300 mW in a SO-8 package.

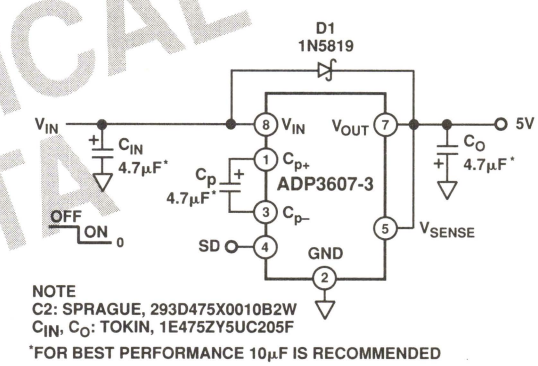
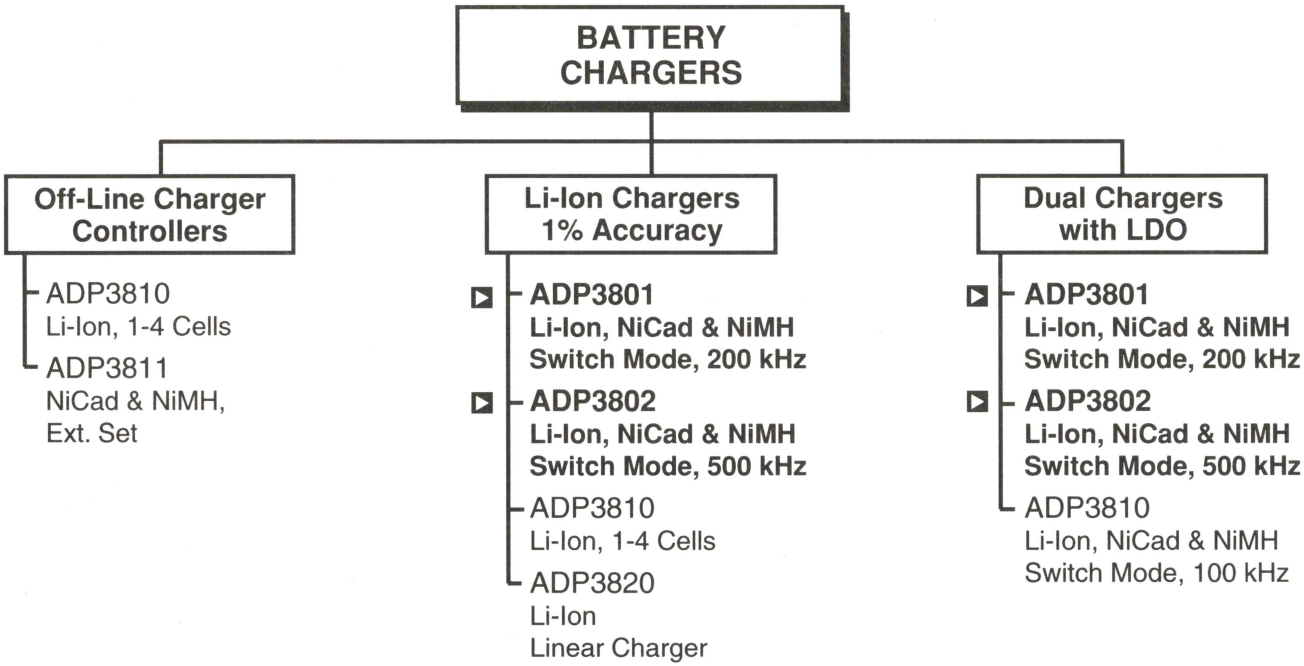


Figure 1. Typical Application Circuit

REV. 0

POWER MANAGEMENT



BATTERY BACKUP

See µPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS Section.

▶ = New Product since *1997 Short Form Designers' Guide.*

POWER MANAGEMENT
Battery Chargers

Off-Line Charger Controllers

Model	No. of Cells Charged	Cell Chemistry	V_{CC} Operating Range	# Pins	Lowest Grade Price 100s	Comments	Fax-code
ADP3810	1 to 4	Li-Ion	2.7 V to 16 V	8	$2.57	±1% Accuracy	2069
ADP3811	Programmable	NiCad, NiMH	2.7 V to 16 V	8	$2.43	±1.8% Accuracy	2069

Li-Ion Chargers with 1% Accuracy

Model	No. of Cells Charged	Cell Chemistry	V_{CC} Operating Range	# Pins	Lowest Grade Price 100s	Comments	Fax-code
ADP3810	1 to 4	Li-Ion	2.7 V to 16 V	8	$2.57	±1% Accuracy	2069
ADP3820	**1**	**Li-Ion**	**5.2 V to 15 V**	**6**	**$TBD**	**±1% Accuracy**	**2139**

Dual Chargers with LDO

Model	No. of Cells Charged	Cell Chemistry	Oscillator Frequency (kHz)	End of Charge Accuracy %	# Pins	Lowest Grade Price 100s	Comments	Fax-code
▶ **ADP3801***	**1 to 9**	**Li-Ion, NiCad, NiMH**	**200**	**1**	**16**	**$2.80**	**Drives Ext. PMOS Transistor**	**2200**
▶ **ADP3802***	**1 to 9**	**Li-Ion, NiCad, NiMH**	**500**	**1**	**16**	**$2.80**	**Drives Ext. PNP Transistor**	**2200**

Battery Backup

See µPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS section.

*Requires microprocess for remote control when used with NiCad Batteries.
▶ = New Product since *1997 Short Form Designers' Guide.*

Switch Mode Dual Charger and LDO Regulator for LiIon, NiCad, and NiMH Batteries

ADP3800/ADP3801/ADP3802

FEATURES

Charges LiIon, NiCAD, NiMH Batteries
Guaranteed ±1% End-of-Charge Voltage
Pin Programmable Chemistry and Cell Number Select
On-Chip LDO Regulator (3.3 V or 5.0 V)
Programmable Charge Current with High Side Sense
Softstart Charge Current after Turn-On
Undervoltage Lock Out
Drives External PMOS (3801/3802)
Drives Extern PNP (3800)
±10% Adjustable End-of-Charge Voltage
Intelligent End-of-Charge Output Signal
PWM Oscillator Frequency:
ADP3800: 100 kHz
ADP3801: 200 kHz
ADP3802: 500 kHz

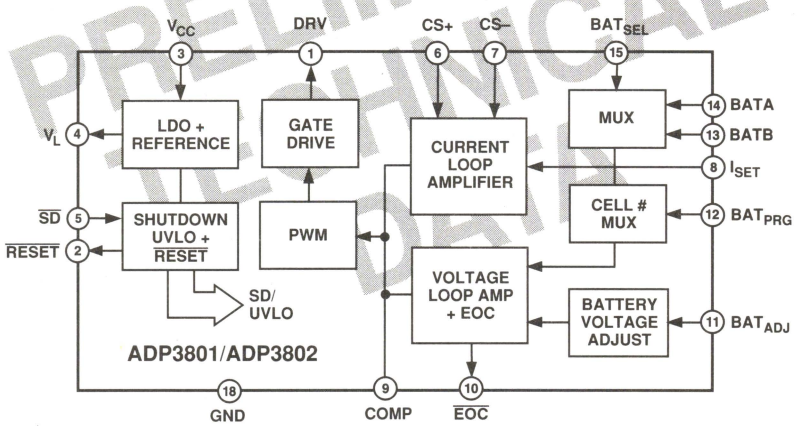
APPLICATIONS

Battery Charger for LiIon, NiCad and NiMH Batteries

GENERAL DESCRIPTION

The ADP3800, ADP3801 and ADP3802 are complete battery charging ICs. The devices combine a high accuracy, final battery voltage control with a constant charge current control and an on-board Low Dropout Regulator (LDO). The accuracy of the final battery voltage control is guaranteed to ±1% to safely charge LiIon batteries. An internal multiplexer allows the alternate charging of two separate battery stacks. The final voltage is pin programmable to one of six options: 4.2 V (one LiIon Cell), 8.4 V (two LiIon cells), 12.6 V (three LiIon cells), 4.5 V (three NiCad/NiMH cells), 9.0 V (six NiCad/NiMH cells), or 13.5 V (nine NiCad/NiMH cells). In addition, a pin is provided for changing the final battery voltage by up to ±10% to adjust for variations in battery chemistry from one LiIon manufacturer to the next.

FUNCTIONAL BLOCK DIAGRAM



5

REV. 0

Secondary Side, Off-Line Battery Charger Controllers

ADP3810/ADP3811

FEATURES

Programmable Charge Current
High Precision Battery Voltage Limit
Precision 2.000 V Reference
Low Voltage Drop Current Sense: 300 mV Full Scale
Full Operation in Shorted and Open Battery Conditions
Drives Diode-Side of Optocoupler
Wide Operating Supply Range: 2.7 V to 16 V
Undervoltage Lockout
SO-8 Package
ADP3810
- **Internal Precision Voltage Divider for Battery Sense**
- **Four Final Battery Voltage Options Available: 4.2 V, 8.4 V, 12.6 V, 16.8 V**

ADP3811
- **Adjustable Final Battery Voltage**

APPLICATIONS

Battery Charger Controller for:
- **Li-Ion Batteries (ADP3810)**
- **NiCad, NiMH Batteries (ADP3811)**

GENERAL DESCRIPTION

The ADP3810 and ADP3811 combine a programmable current limit with a battery voltage limit to provide a constant current, constant voltage battery charger controller. In secondary side, off-line applications, the output directly drives the diode side of an optocoupler to give isolated feedback control of a primary side PWM. The circuitry includes two gain (g_m) stages, a precision 2.0 V reference, a control input buffer, an Undervoltage Lock Out (UVLO) comparator, an output buffer and an overvoltage comparator.

The current limit amplifier senses the voltage drop across an external sense resistor to control the average current for charging a battery. The voltage drop can be adjusted from 25 mV to 300 mV, giving a charging current limit from 100 mA to 1.2 amps with a 0.25 Ω sense resistor. An external dc voltage on the V_{CTRL} input sets the voltage drop. Because this input is high impedance, a filtered PWM output can be used to set the voltage.

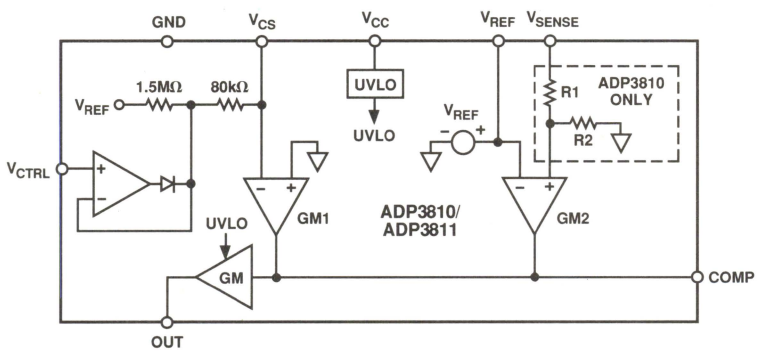
As the battery voltage approaches its voltage limit, the voltage sense amplifier takes over to maintain a constant battery voltage. The two amplifiers essentially operate in an "OR" fashion. Either the current is limited, or the voltage is limited.

The ADP3810 has internal thin-film resistors that are trimmed to provide a precise final voltage for Li-Ion batteries. Four voltage options are available, corresponding to 1-4 Li-Ion cells as follows: 4.2 V, 8.4 V, 12.6 V and 16.8 V.

The ADP3811 omits these resistors allowing any battery voltage to be programmed with external resistors.

5

FUNCTIONAL BLOCK DIAGRAM



REV. 0

ANALOG DEVICES

Lithium-Ion Battery Charger

ADP3820

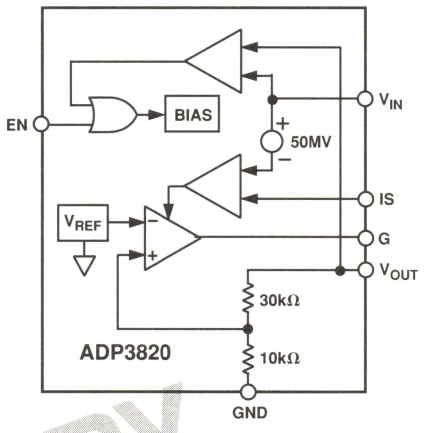
FEATURES

1% Accuracy
Low Power BiCMOS: 600 μA Quiescent Current
Shutdown Mode: 1 μA Battery Load
14.5 V to 116.5 V Operating Range
Four Fixed Output Voltage Options
Up to 1 A Output Current
6-Lead SOT-23 Package
Programmable Charge Current

APPLICATIONS

Li-Ion Backup Systems
Desktop Computers
Handheld Instruments
Cellular Telephones
Battery Operated Devices
Battery Chargers

FUNCTIONAL BLOCK DIAGRAMS



GENERAL DESCRIPTION

The ADP3820 is precision Li-Ion battery charge controller which can be used with an external power PMOS device such as the IRFR9014 to form a two chip low dropout linear charger. Four voltage options accommodate one or two cell configurations of Li-Ion batteries with coke or graphite anodes. The charge current is set by an external resistor or printed circuit board trace resistance. A 50 mΩ of board metal trace resistance limits the charge current to 1 A. Other PMOS devices can be selected to provide higher output current levels and lower dropout. A wide input voltage range from 2.5 V to 16.5 V is allowable. A gate to source voltage clamp is provided to protect the external PMOS device.

The ADP3820 is specified over the industrial temperature range –40°C to +85°C and is available in the ultrasmall 6-pin surface mount SOT-23 package.

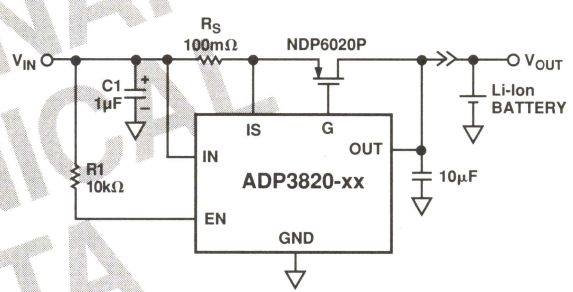


Figure 1. Typical LiLon Charger Application Circuit

5

REV. 0

POWER MANAGEMENT

DC-to-DC Converter Modules 6

DC-TO-DC* CONVERTER MODULES

HIGH POWER HYBRIDS

V_{IN} = 16 V to 50 V

ADDC02803SC (V_{OUT} = +3 V @ 20 Amps)
ADDC02805SA (V_{OUT} = +5 V @ 20 Amps)
ADDC02808PB (V_{OUT} = +8 V @ 25 Amps Pulsed)
ADDC02809SA (V_{OUT} = +9 V @ 11.1 Amps)
ADDC02812DA (V_{OUT} = ±12 V @ 8.34 Amps Total)
ADDC02815DA (V_{OUT} = ±15 V @ 6.68 Amps Total)
ADDC02828SA (V_{OUT} = +28 V @ 3.6 Amps)

V_{IN} = 160 V to 400 V

ADDC27005SA (V_{OUT} = +5 V @ 20 Amps Pulsed)
ADDC27008PB (V_{OUT} = +8 V @ 6.6 Amps Pulsed)

*Non-Monolithic Circuits

POWER MANAGEMENT
DC-to-DC Converter Modules

Model	V dc Input Volts	V dc Out Volts	I_{OUT} Max Amps	Line Regulation mV	Load Regulation mV	Delta V_{OUT} 50% Step V	Response Time µs	Watts Max	Lowest Grade Price 100s	Comments	Fax-code
High Power Hybrids											
ADDC02803SC	16 to 50	3.3	20	1	1	0.36	140	66	$775.00	Integral EMI Filters	1947
ADDC02805SA	16 to 50	5	20	1	1	0.5	125	100	$775.00	Integral EMI Filters	1947
ADDC02808PB	16 to 50	8	25 Pulsed	1	2.5	See D/S	See D/S	200	$775.00	Optimized for Pulsed Loads	2071
ADDC02809SA	16 to 50	9	11.1	2	2	0.65	110	100	$775.00	Integral EMI Filters	CF
ADDC02812DA	16 to 50	±12	8.34 Total	4	4	0.85	150	100	$775.00	Integral EMI Filters	2012
ADDC02815DA	16 to 50	±15	6.68 Total	5	6	0.85	150	100	$775.00	Integral EMI Filters	2012
ADDC02828SA	16 to 50	28	3.6	30	30	See D/S	See D/S	100	$775.00	Optimized for Pulsed Loads	2101
ADDC27005SA	16 to 50	5	20	5	5	0.5	170	100	$775.00	Integral EMI Filters	2099
ADDC27008PB	16 to 50	8	25 Pulsed	5	10	See D/S	See D/S	200	$775.00	Optimized for Pulsed Loads	2100

NOTES FOR ADDC MODELS
1. All products are manufactured in a hermetically sealed, molybdenum hybrid package. Typical weight for each product is 85 grams.
2. All products are available in three screening/price levels: industrial, ruggedized industrial, 883B/SMD.
3. Contact factory for modified standard versions and for information on lower power product line in development.

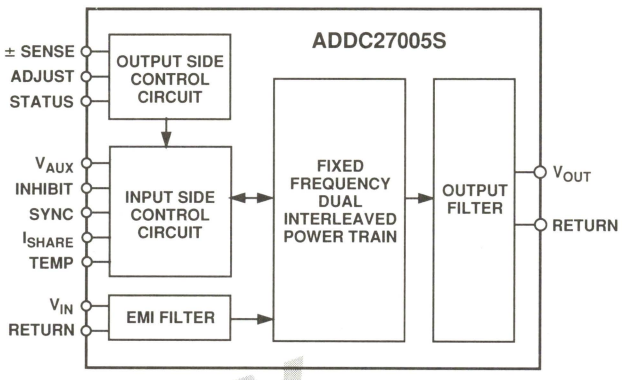
270 V/100 W Pulsed DC/DC Converter with Integral EMI Filter

ADDC27005S

FEATURES
270 V dc Input, 5 V dc @ 20 A, 100 W
Integral EMI Filter, Meets CE03
Low Weight: 90 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS
Commercial and Military Airborne Electronics
Missile Electronics
Space-Based Antennae and Vehicles
Mobile/Portable Ground Equipment
Distributed Power Architecture for Active Array Radar

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC27005S hybrid military dc/dc converter with integral EMI filter offers the highest power density of any military power converter with its features and in its power range available today. The converter with integral EMI filter is a fixed frequency, 1 MHz, square wave switching dc/dc power supply. It is not a variable frequency resonant converter. In addition to many protection features, this converter has system level features which allows it to be used as a component in larger systems as well as a stand-alone power supply. The unit is designed for high reliability and high performance applications where saving space and/or weight are critical.

The ADDC27005S is available in a hermetically sealed, molybdenum based hybrid package and is easily heatsink mountable. For MIL-STD-883 devices, contact the factory for availability.

PRODUCT HIGHLIGHTS

1. 60 W/cubic inch pulsed power density with integral EMI filter passes stand-alone CE03 test with three small external components
2. High efficiency
3. Light weight: 90 grams. Lighter composite packages are available.
4. Operational and survivable over a wide range of input conditions: 160 V–440 V dc; survives low line and high. Contact factory for availability of units with modified input voltage range.
5. High reliability; NAVMAT derated with minor exceptions.
6. Protection features include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
7. System level features include:
   Current Sharing for Parallel Operation
   Logic Level Disable
   Output Status Signal
   Synchronization for Multiple Units
   Auxiliary Low Level Voltage Referenced to Input Return

REV. 0

270 V, 200 W Pulsed DC/DC Converter with Integral EMI Filter

ADDC27008PB

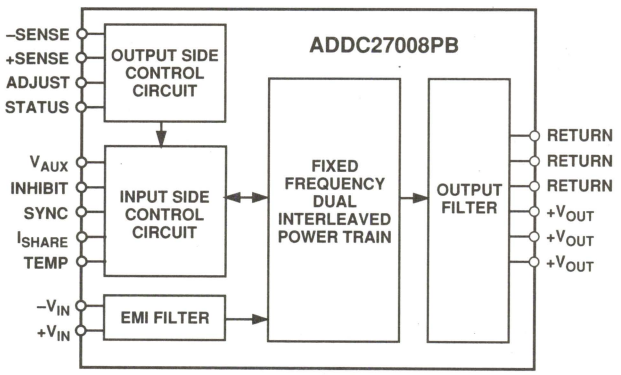
FEATURES

270 V dc Input, 8 V dc @ 25 A, 200 W Pulse Output
Integral EMI Filter
Ultrafast Transient Response
Minimal Output Voltage Deviation
Low Weight: 80 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS

Distributed Power Architecture for Driving T/R Modules
Motor and Actuator Drivers

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC27008PB hybrid military dc/dc converter is compensated specifically for pulse applications where fast transient response and minimum output voltage deviation are required. It is also designed to deliver very high, pulsed output power. The unit is designed for high reliability and high performance applications where saving space and/or weight are critical.

The ADDC27008PB has been characterized over a wide variety of load conditions. Its transient response has been set to insure output stability over a broad range of load capacitance. For applications that require factory modified compensation optimized for a specific load, or for applications that require a different output voltage than 8 V dc, contact the factory.

The ADDC27008PB is available in a hermetically sealed, molybdenum based hybrid package and is easily heatsink mountable. For MIL-STD-883 devices, contact the factory for availability.

PRODUCT HIGHLIGHTS

1. 120 W/cubic inch pulsed power density with an integral EMI filter
2. Ultrafast transient response time with minimum output voltage deviation
3. Light weight: 80 grams
4. Operational and survivable over a wide range of input conditions: 160 V–440 V dc; survives low line, high line
5. High reliability; NAVMAT derated
6. Protection features include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
7. System level features include:
   Current Sharing for Parallel Operation
   Logic Level Disable
   Output Status Signal
   Synchronization for Multiple Units
   Input Referenced Auxiliary Voltage Supply

REV. 0

28 V/66 W/100 W DC/DC Converters with Integral EMI Filter

ADDC02803SC/ADDC02805SA

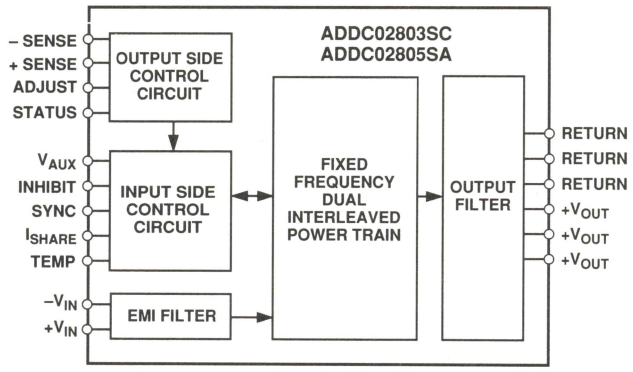
FEATURES

28 V dc Input, 5 V dc @ 20 A, 100 W Output (ADDC02805SA)
28 V dc Input, 3.3 V dc @ 20 A, 66 W Output (ADDC02803SC)
Integral EMI Filter Designed to Meet MIL-STD-461D
Low Weight: 80 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS

Commercial and Military Airborne Electronics
Missile Electronics
Space-Based Antennae and Vehicles
Mobile/Portable Ground Equipment
Distributed Power Architecture for Active Array Radar

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC02803SC and ADDC02805SA hybrid dc/dc converters with integral EMI filters offer the highest power density of any dc/dc converter with their features and in their power range available today. The converters with integral EMI filters are fixed frequency, 1 MHz square wave switching dc/dc power supplies. They are not variable frequency resonant converters. In addition to many protection features, these converters have system level features that allow them to be used as components in larger systems as well as stand-alone power supplies. The units are designed for high reliability and high performance applications where saving space and/or weight are critical.

The ADDC02803SC and ADDC02805SA are available in three screening grades; all grades use a hermetically sealed, molybdenum based hybrid package. Contact factory for MIL-STD-883 device availability.

PRODUCT HIGHLIGHTS

1. Up to 60 W/cubic inch power density with an integral EMI filter designed to meet all applicable requirements in MIL-STD-461D when installed in a typical system setup.
2. Light weight: 80 grams
3. Operational and survivable over a wide range of input conditions: 16 V–50 V dc; survives low line, high line and positive and negative transients. See section entitled: Input Voltage Range.
4. High reliability; NAVMAT derated
5. Protection features include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
6. System level features include:
   Current Sharing for Parallel Operation
   Inhibit Control
   Output Status Signal
   Synchronization for Multiple Units
   Input Referenced Auxiliary Voltage Supply

REV. 0

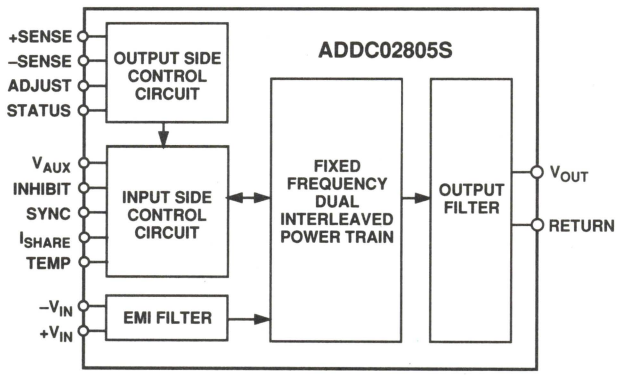
28 V/100 W DC/DC Converter with Integral EMI Filter

ADDC02805S

FEATURES
28 V dc Input, 5 V dc @ 20 A, 100 W Output
Integral EMI Filter Designed to Meet MIL-STD-461D
Low Weight: 80 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS
Commercial and Military Airborne Electronics
Missile Electronics
Space-Based Antennae and Vehicles
Mobile/Portable Ground Equipment
Distributed Power Architecture for Active Array Radar

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC02805S hybrid dc/dc converter with integral EMI filter offers the highest power density of any dc/dc converter with its features and in its power range available today. The converter with integral EMI filter is a fixed frequency, 1 MHz, square wave switching dc/dc power supply. It is not a variable frequency resonant converter. In addition to many protection features, this converter has system level features that allow it to be used as a component in larger systems as well as a stand-alone power supply. The unit is designed for high reliability and high performance applications where saving space and/or weight are critical.

The ADDC02805S is available in three screening grades; all grades use a hermetically sealed, molybdenum based hybrid package. Contact factory for MIL-STD-883 device availability.

PRODUCT HIGHLIGHTS

1. 60 W/cubic inch power density with an integral EMI filter designed to meet all applicable requirements in MIL-STD-461D when installed in a typical system setup.
2. Light weight: 80 grams
3. Operational and survivable over a wide range of input conditions: 16 V–50 V dc; survives low line, high line, and positive and negative transients. See section entitled: Input Voltage Range.
4. High reliability; NAVMAT derated
5. Protection features include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
6. System level features include:
   Current Sharing for Parallel Operation
   Inhibit Control
   Output Status Signal
   Synchronization for Multiple Units
   Input Referenced Auxiliary Voltage Supply

REV. 0

8 V/200 W Pulsed DC/DC Converter with Integral EMI Filter

ADDC02808PB

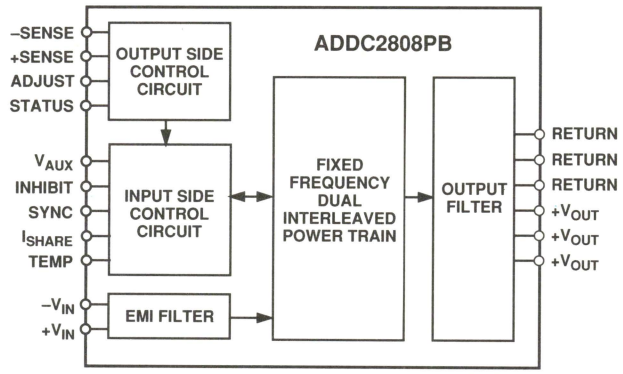
FEATURES

28 V dc Input, 8 V dc @ 25 A, 200 W Pulse Output
Integral EMI Filter
Ultrafast Transient Response
Minimal Output Voltage Deviation
Low Weight: 80 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS

Distributed Power Architecture for Driving T/R Modules
Motor and Actuator Drivers

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC02808PB hybrid military dc/dc converter is compensated specifically for pulse applications where fast transient response and minimum output voltage deviation are required. It is also designed to deliver very high, pulsed output power. The unit is designed for high reliability and high performance applications where saving space and/or weight are critical.

The ADDC02808PB has been characterized over a wide variety of load conditions. Its transient response has been set to insure output stability over a broad range of load capacitance. For applications that require factory modified compensation optimized for a specific load, or for applications that require a different output voltage than 8 V dc, contact the factory.

The ADDC02808PB is available in a hermetically sealed, molybdenum based hybrid package and is easily heatsink mountable. For MIL-STD-883 devices, contact the factory for availability.

PRODUCT HIGHLIGHTS

1. 120 W/cubic inch pulsed power density with an integral EMI filter
2. Ultrafast transient response time with minimum output voltage deviation
3. Light weight: 80 grams
4. Operational and survivable over a wide range of input conditions: 16 V–50 V dc; survives low line, high line
5. High reliability; NAVMAT derated
6. Protection features include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
7. System level features include:
   Current Sharing for Parallel Operation
   Logic Level Disable
   Output Status Signal
   Synchronization for Multiple Units
   Input Referenced Auxiliary Voltage Supply

REV. 0

ANALOG DEVICES

28 V/100 W DC/DC Converters with Integral EMI Filter

ADDC02812DA/ADDC02815DA

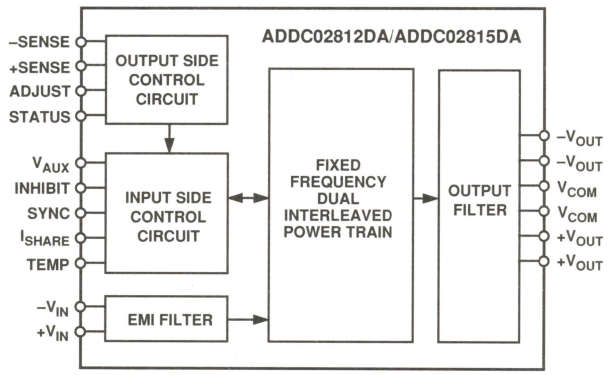
FEATURES

28 V dc Input, ±12 V dc @ 8.34 A, 100 W Output (ADDC02812DA)
28 V dc Input, ±15 V dc @ 6.68 A, 100 W Output (ADDC02815DA)
Integral EMI Filter Designed to Meet MIL-STD-461D
Low Weight: 80 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS

Commercial and Military Airborne Electronics
Missile Electronics
Space-Based Antennae and Vehicles
Mobile/Portable Ground Equipment

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC02812DA and ADDC02815DA hybrid military dc/dc converters with integral EMI filter offer the highest power density of any dc/dc power converters with their features and in their power range available today. The converters with integral EMI filter are a fixed frequency, 1 MHz, square wave switching dc/dc power supply. They are not variable frequency resonant converters. In addition to many protection features, these converters have system level features that allow them to be used as a component in larger systems as well as a stand-alone power supply. The units are designed for high reliability and high performance applications where saving space and/or weight are critical.

The ADDC02812DA and ADDC02815DA are available in a hermetically sealed, molybdenum based hybrid package and are easily heatsink mountable. Three screening levels are available, including military SMD.

PRODUCT HIGHLIGHTS

1. 60 W/cubic inch power density with an integral EMI filter designed to meet all applicable requirements in MIL-STD-461D when installed in a typical system setup
2. Light weight: 80 grams
3. Operational and survivable over a wide range of input conditions: 16 V–50 V dc; survives low line, high line, and positive and negative transients
4. High reliability; NAVMAT derated
5. Protection features include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
6. System level features include:
   Current Sharing for Parallel Operation
   Inhibit Control
   Output Status Signal
   Synchronization for Multiple Units
   Input Referenced Auxiliary Voltage

REV. A

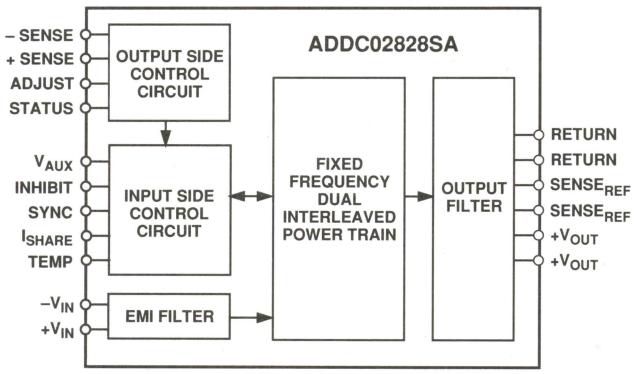
28 V/100 W DC/DC Converter with Integral EMI Filter

ADDC02828SA

FEATURES
28 V dc Input, 28 V dc @ 3.6 A, 100 W Output
Integral EMI Filter Designed to Meet MIL-STD-461D
Low Weight: 80 Grams
NAVMAT Derated
Many Protection and System Features

APPLICATIONS
Commercial and Military Airborne Electronics
Missile Electronics
Space-Based Antennae and Vehicles
Mobile/Portable Ground Equipment
Distributed Power Architecture for Active Array Radar

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADDC02828SA hybrid dc/dc converter with integral EMI filter offers the highest power density of any dc/dc converter available today with its features and in its power range. The converter with integral EMI filter is a fixed frequency, 1 MHz, square wave switching dc/dc power supply. It is not a variable frequency resonant converter. In addition to many protection features, this converter has system level features that allow it to be used as a component in larger systems as well as a stand-alone power supply. The unit is designed for high reliability and high performance applications where saving space and/or weight is critical.

The ADDC02828SA is available in three screening grades; all grades use a hermetically sealed, molybdenum based hybrid package. Contact factory for MIL-STD-883 device availability.

PRODUCT HIGHLIGHTS

1. 60 W/cubic inch power density with an integral EMI filter designed to meet all applicable requirements in MIL-STD-461D when installed in a typical system setup.
2. Light weight: 80 grams
3. Operational and survivable over a wide range of input conditions: 16 V–50 V dc; survives low line, high line and positive and negative transients. See Input Voltage Range section.
4. High reliability; NAVMAT derated
5. Protection Features Include:
   Output Overvoltage Protection
   Output Short Circuit Current Protection
   Thermal Monitor/Shutdown
   Input Overvoltage Shutdown
   Input Transient Protection
6. System Level Features Include:
   Current Sharing for Parallel Operation
   Inhibit Control
   Output Status Signal
   Synchronization for Multiple Units
   Input Referenced Auxiliary Voltage Supply

SENSORS AND SIGNAL CONDITIONERS

Temperature Sensors, Temperature Controllers and Signal Conditioners

7

SENSORS AND SIGNAL CONDITIONERS

TEMPERATURE SENSORS

Current Output

AD590	(1 μA/K [TO-52])
AD592	(1 μA/K [TO-92])
TMP17	(1 μA/K [SOIC-8])

Ratiometric Output

AD22100	(22.5 mV/°C, +5 V Supply)
AD22103	(28 mV/°C, +3 V Supply)

Voltage Output

TMP3x Series	(w Shutdown)
TMP35	(V_{OUT} = 250 mV,10 mV/°C)
TMP36	(V_{OUT} = 750 mV,10 mV/°C)
TMP37	(V_{OUT} = 500 mV, 20 mV/°C)
▶ **ADT45**	**(V_{OUT} = 250 mV,10 mV/°C, SOT-23-3)**
▶ **ADT50**	**(V_{OUT} = 750 mV,10 mV/°C, SOT-23-3)**

Digital Output

▶ **AD7416**	**(10-Bit A/D Output, I^2C I/O)**
AD7816/17/18	(10-Bit A/D Output, SPI I/O)
TMP03	(PWM, Open Collector)
TMP04	(PWM, TTL/CMOS)

TEMPERATURE CONTROLLERS

TMP01	(°F/°C w/Window Comparator)
TMP12	(w/Window Comparator, "Heater" Input)
AD594/AD596	(J Thermocouple)
AD595/AD597	(K Thermocouple)
AD22105	(Programmable –40°C to +125°C, 1 Output)

SIGNAL CONDITIONERS

Thermocouple

AD594/AD596	(J)
AD595/AD597	(K)

RTD, Platinum

ADT70	(w/V_{REF})

▶ = New Product since *1997 Short Form Designers' Guide.*

SENSORS AND SIGNAL CONDITIONERS

Temperature Sensors

Model	Output 25°C	Output Scale Factor	Accuracy +25°C	Linearity °C	Operating Range °C	Digital Output	Supply Range Volts	I_Q µA	# Pins	Lowest Grade Price 100s	Comments	Fax-code
Current Output												
AD590	298.2 µA	1 µA/K	±0.5 µA to 5 µA	1.5	–55 to +150	NA	+4 to +30	$I_{OUT} = I_Q$	3	$2.50		1186
AD592	298.2 µA	1 µA/K	±0.5 µA to 1 µA	0.4 to 0.5	–55 to +150	NA	+4 to +30	$I_{OUT} = I_Q$	3	$2.21	AD590 in Plastic Pack	1187
TMP17	298.2 µA	1 µA/K	60.5 µA to 1 µA	0.4 to 0.5	–40 to +105	NA	+4 to +30	$I_{OUT} = I_Q$	8	$1.10	AD590 in SOIC	2040
ADT18	298.2 µA	2 µA/K	60.5 µA to 1 µA	0.4 to 0.5	–55 to +150	NA	+2.7 to +7	$I_{OUT} = I_Q$	3	$1.10		2121
ADT19	298.2 µA	5 µA/K	60.5 µA to 1 µA	0.4 to 0.5	–55 to +150	NA	+2.7 to +7	$I_{OUT} = I_Q$	3	$1.10		2121
Ratiometric Output												
AD22100	1.375 V	22.5 mV/°C	±2	1% FS	–50 to +150	NA	+4 to +6	650	3/8	$2.63	V_{OUT} Proportional to V_{DD}	1091
AD22103	0.25 V	28 mV/°C	±2	0.5% FS	–50 to +150	NA	+2.7 to +3.6	600	3/8	$1.48	V_{OUT} Proportional to V_{DD}	1861
Voltage Output												
TMP35	250 mV	10 mV/°C	±2 to 3°C	0.5	+10 to +125	NA	+2.7 to +5.5	50	3/5/8	$0.85	I_{OUT} = 0.5 µA in Shutdown	1972
TMP36	750 mV	10 mV/°C	±2 to 3°C	0.5	–40 to +125	NA	+2.7 to +5.5	50	3/5/8	$0.85	I_{OUT} = 0.5 µA in Shutdown	1972
TMP37	500 mV	20 mV/°C	±2 to 3°C	0.5	+5 to +100	NA	+2.7 to +5.5	50	3/5/8	$0.85	I_{OUT} = 0.5 µA in Shutdown	1972
▶ **ADT45**	**250 mV**	**10 mV/°C**	**3°C**	**0.5**	**+10 to +125**	**NA**	**+2.7 to +5.5**	**50**	**3**	**$0.85**	**LM45 Pinout, 1000 pF Load**	**2258**
▶ **ADT50**	**750 mV**	**10 mV/°C**	**3°C**	**0.5**	**–40 to +125**	**NA**	**+2.7 to +5.5**	**50**	**3**	**$0.85**	**LM50 Pinout, 1000 pF Load**	**2258**
Digital Output (Equations Apply to Both TMP03 & TMP04)												
TMP03	35 Hz	°C = 235 – (400 × T1)/T2	±2	±1	–55 to +150	1 Open Col	+4.5 to +7	1000	3/8	$2.95	PWM Output	1850
TMP04	35 Hz	°F = 455 – (720 × T1)/T2	±2	±1	–55 to +150	TTL/CMOS	+4.5 to +7	1000	3/8	$2.95	PWM Output	1850
AD7416	10 Bits	10-Bit A/D	±2, ±3	1 Bit	–40 to +85	I^2C	+2.7 to +5.5	1500	16	$1.72	40 µW Shutdown, SPI I/O	2092
AD7816	10 Bits	10-Bit A/D	±2, ±3	1 Bit	–40 to +85	Serial	+2.7 to +5.5	1500	16	$1.72	40 µW Shutdown, SPI I/O	2209

▶ = New Product since *1997 Short Form Designers' Guide.*

SENSORS AND SIGNAL CONDITIONERS

Temperature Controllers

Model	Output 25°C	Output Scale Factor	Accuracy +25°C	Linearity °C	Operating Range °C	Digital Output	Supply Range Volts	I_Q µA	# Pins	Lowest Grade Price 100s	Comments	Fax-code
AD22105	NA	NA	±2	NA	–40 to +150	1 Open Col	+2.7 to +7		6/8	$1.37	User Programmable Thermostat	1974
TMP12	NA	NA	±3	0.5 typ	–40 to +125	2 Open Col	+4.5 to +12	600	8	$1.95	Controller, with Window Comparator Heater Input, and Resistor Prgm Hysteresis	1970
TMP01	1.49 V	5 mV/K	±1.5 ± –3	0.5 typ	–55 to +150	2 Open Col	+4.5 to +13.2	800	8	$2.31	With Temperature Output	1807
AD594	0.25	10 mV/°C	1 to 3		+25 to +100	1 Open Col	+5 to ±15	300	14	$7.28	J Thermocouple	1189
AD595	0.25	10 mV/°C	1 to 3		+25 to +100	1 Open Col	+5 to ±15	300	14	$7.28	K Thermocouple	1189
AD596	0.282	10 mV/°C	4		+25 to +100	1 Open Col	+5 to ±15	160	8/10	$8.09	J Thermocouple	1190
AD597	0.282	10 mV/°C	4		+25 to +100	1 Open Col	+5 to ±15	160	8/10	$4.15	K Thermocouple	1190

SENSORS AND SIGNAL CONDITIONERS

Signal Conditioners: Nonisolated

Thermocouple

Model	Output 25°C	Output Scale Factor	Accuracy +25°C	Operating Range °C	Digital Output	Supply Range Volts	I_Q µA	# Pins	Lowest Grade Price 100s	Comments	Fax-code
AD594	0.25	10 mV/°C	1 to 3	+25 to +100	1 Open Col	+5 to ±15	300	14	$ 7.28	J Thermocouple	1188
AD595	0.25	10 mV/°C	1 to 3	+25 to +100	1 Open Col	+5 to ±15	300	14	$ 7.28	K Thermocouple	1188
AD596	0.282	10 mV/°C	4	+25 to +100	1 Open Col	+5 to ±15	160	8/10	$ 8.09	J Thermocouple	1190
AD597	0.282	10 mV/°C	4	+25 to +100	1 Open Col	+5 to ±15	160	8/10	$ 4.15	K Thermocouple	1190

RTD, Platinum

Model	Instrument E_{OS} RTI	Amp E_{OS} RTO	Output Amp E_{OS}	V_{REF} Volts	V_{CC} Volts	I_Q mA	# Current Sources	# Pins	Lowest Grade Price 100s	Comments	Fax-code
ADT70F	200 µV	500 µV	50 µV	+2.5	+5	3	2 @ 1 mA	20	$ 4.85	±0.5 mA I_{CS} Mismatch	2123
ADT70G	500 µV	1000 µV	50 µV	+2.5	+5	3	2 @ 1 mA	20	$ 7.43	±0.5 mA I_{CS} Mismatch	2123

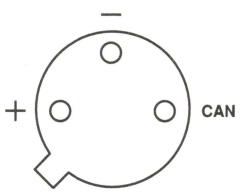
ANALOG DEVICES

Two-Terminal IC Temperature Transducer

AD590

FEATURES
Linear Current Output: 1 μA/K
Wide Range: –55°C to +150°C
Probe Compatible Ceramic Sensor Package
Two Terminal Device: Voltage In/Current Out
Laser Trimmed to ±0.5°C Calibration Accuracy (AD590M)
Excellent Linearity: ±0.3°C Over Full Range (AD590M)
Wide Power Supply Range: +4 V to +30 V
Sensor Isolation from Case
Low Cost

PIN DESIGNATIONS



BOTTOM VIEW

PRODUCT DESCRIPTION

The AD590 is a two-terminal integrated circuit temperature transducer that produces an output current proportional to absolute temperature. For supply voltages between +4 V and +30 V the device acts as a high impedance, constant current regulator passing 1 μA/K. Laser trimming of the chip's thin-film resistors is used to calibrate the device to 298.2 μA output at 298.2K (+25°C).

The AD590 should be used in any temperature sensing application below +150°C in which conventional electrical temperature sensors are currently employed. The inherent low cost of a monolithic integrated circuit combined with the elimination of support circuitry makes the AD590 an attractive alternative for many temperature measurement situations. Linearization circuitry, precision voltage amplifiers, resistance measuring circuitry and cold junction compensation are not needed in applying the AD590.

In addition to temperature measurement, applications include temperature compensation or correction of discrete components, biasing proportional to absolute temperature, flow rate measurement, level detection of fluids and anemometry. The AD590 is available in chip form making, it suitable for hybrid circuits and fast temperature measurements in protected environments.

The AD590 is particularly useful in remote sensing applications. The device is insensitive to voltage drops over long lines due to its high impedance current output. Any well insulated twisted pair is sufficient for operation hundreds of feet from the receiving circuitry. The output characteristics also make the AD590 easy to multiplex: the current can be switched by a CMOS multiplexer or the supply voltage can be switched by a logic gate output.

PRODUCT HIGHLIGHTS

1. The AD590 is a calibrated two terminal temperature sensor requiring only a dc voltage supply (+4 V to +30 V). Costly transmitters, filters, lead wire compensation and linearization circuits are all unnecessary in applying the device.
2. State-of-the-art laser trimming at the wafer level in conjunction with extensive final testing ensures that AD590 units are easily interchangeable.
3. Superior interface rejection results from the output being a current rather than a voltage. In addition, power requirements are low (1.5 mWs @ 5 V @ +25°C.) These features make the AD590 easy to apply as a remote sensor.
4. The high output impedance (>10 MΩ) provides excellent rejection of supply voltage drift and ripple. For instance, changing the power supply from 5 V to 10 V results in only a 1 μA maximum current change, or 1°C equivalent error.
5. The AD590 is electrically durable: it will withstand a forward voltage up to 44 V and a reverse voltage of 20 V. Hence, supply irregularities or pin reversal will not damage the device.

REV. B

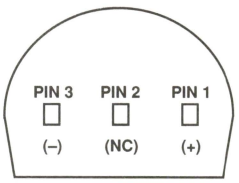
Low Cost, Precision IC Temperature Transducer

AD592*

FEATURES

High Precalibrated Accuracy: 0.5°C max @ +25°C
Excellent Linearity: 0.15°C max (0°C to +70°C)
Wide Operating Temperature Range: –25°C to +105°C
Single Supply Operation: +4 V to +30 V
Excellent Repeatability and Stability
High Level Output: 1 μA/K
Two Terminal Monolithic IC: Temperature In/ Current Out
Minimal Self-Heating Errors

FUNCTIONAL BLOCK DIAGRAMS



★ PIN 2 CAN BE EITHER ATTACHED OR UNCONNECTED
BOTTOM VIEW

PRODUCT DESCRIPTION

The AD592 is a two terminal monolithic integrated circuit temperature transducer that provides an output current proportional to absolute temperature. For a wide range of supply voltages the transducer acts as a high impedance temperature dependent current source of 1 μA/K. Improved design and laser wafer trimming of the IC's thin film resistors allows the AD592 to achieve absolute accuracy levels and nonlinearity errors previously unattainable at a comparable price.

The AD592 can be employed in applications between –25°C and +105°C where conventional temperature sensors (i.e., thermistor, RTD, thermocouple, diode) are currently being used. The inherent low cost of a monolithic integrated circuit in a plastic package, combined with a low total parts count in any given application, make the AD592 the most cost effective temperature transducer currently available. Expensive linearization circuitry, precision voltage references, bridge components, resistance measuring circuitry and cold junction compensation are not required with the AD592.

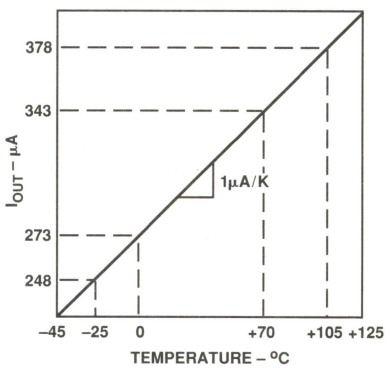
Typical application areas include: appliance temperature sensing, automotive temperature measurement and control, HVAC (heating/ventilating/air conditioning) system monitoring, industrial temperature control, thermocouple cold junction compensation, board-level electronics temperature diagnostics, temperature readout options in instrumentation, and temperature correction circuitry for precision electronics. Particularly useful in remote sensing applications, the AD592 is immune to voltage drops and voltage noise over long lines due to its high impedance current output. AD592s can easily be multiplexed; the signal current can be switched by a CMOS multiplexer or the supply voltage can be enabled with a tri-state logic gate.

The AD592 is available in three performance grades: the AD592AN, AD592BN and AD592CN. All devices are packaged in a plastic TO-92 case rated from –45°C to +125°C. Performance is specified from –25°C to +105°C. AD592 chips are also available, contact the factory for details.

***Protected by Patent No. 4,123,698.**

PRODUCT HIGHLIGHTS

1. With a single supply (4 V to 30 V) the AD592 offers 0.5°C temperature measurement accuracy.
2. A wide operating temperature range (–25°C to +105°C) and highly linear output make the AD592 an ideal substitute for older, more limited sensor technologies (i.e., thermistors, RTDs, diodes, thermocouples).
3. The AD592 is electrically rugged; supply irregularities and variations or reverse voltages up to 20 V will not damage the device.
4. Because the AD592 is a temperature dependent current source, it is immune to voltage noise pickup and IR drops in the signal leads when used remotely.
5. The high output impedance of the AD592 provides greater than 0.5°C/V rejection of supply voltage drift and ripple.
6. Laser wafer trimming and temperature testing insures that AD592 units are easily interchangeable.
7. Initial system accuracy will not degrade significantly over time. The AD592 has proven long-term performance and repeatability advantages inherent in integrated circuit design and construction.



REV. A

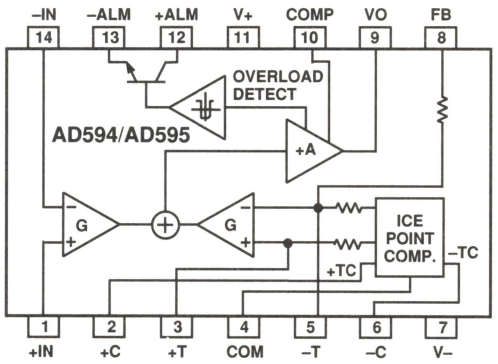
Monolithic Thermocouple Amplifiers with Cold Junction Compensation

AD594/AD595

FEATURES

Pretrimmed for Type J (AD594) or Type K (AD595) Thermocouples
Can Be Used with Type T Thermocouple Inputs
Low Impedance Voltage Output: 10 mV/°C
Built-In Ice Point Compensation
Wide Power Supply Range: +5 V to ±15 V
Low Power: <1 mW typical
Thermocouple Failure Alarm
Laser Wafer Trimmed to 1°C Calibration Accuracy
Setpoint Mode Operation
Self-Contained Celsius Thermometer Operation
High Impedance Differential Input
Side-Brazed DIP or Low Cost Cerdip

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD594/AD595 is a complete instrumentation amplifier and thermocouple cold junction compensator on a monolithic chip. It combines an ice point reference with a precalibrated amplifier to produce a high level (10 mV/°C) output directly from a thermocouple signal. Pin-strapping options allow it to be used as a linear amplifier-compensator or as a switched output setpoint controller using either fixed or remote setpoint control. It can be used to amplify its compensation voltage directly, thereby converting it to a stand-alone Celsius transducer with a low impedance voltage output.

The AD594/AD595 includes a thermocouple failure alarm that indicates if one or both thermocouple leads become open. The alarm output has a flexible format which includes TTL drive capability.

The AD594/AD595 can be powered from a single ended supply (including +5 V) and by including a negative supply, temperatures below 0°C can be measured. To minimize self-heating, an unloaded AD594/AD595 will typically operate with a total supply current 160 μA, but is also capable of delivering in excess of ±5 mA to a load.

The AD594 is precalibrated by laser wafer trimming to match the characteristic of type J (iron-constantan) thermocouples and the AD595 is laser trimmed for type K (chromel-alumel) inputs. The temperature transducer voltages and gain control resistors are available at the package pins so that the circuit can be recalibrated for the thermocouple types by the addition of two or three resistors. These terminals also allow more precise calibration for both thermocouple and thermometer applications.

The AD594/AD595 is available in two performance grades. The C and the A versions have calibration accuracies of ±1°C and ±3°C, respectively. Both are designed to be used from 0°C to +50°C, and are available in 14-pin, hermetically sealed, side-brazed ceramic DIPs as well as low cost cerdip packages.

PRODUCT HIGHLIGHTS

1. The AD594/AD595 provides cold junction compensation, amplification, and an output buffer in a single IC package.
2. Compensation, zero, and scale factor are all precalibrated by laser wafer trimming (LWT) of each IC chip.
3. Flexible pinout provides for operation as a setpoint controller or a stand-alone temperature transducer calibrated in degrees Celsius.
4. Operation at remote application sites is facilitated by low quiescent current and a wide supply voltage range +5 V to dual supplies spanning 30 V.
5. Differential input rejects common-mode noise voltage on the thermocouple leads.

REV. B

Thermocouple Conditioner and Set-Point Controller

AD596*/AD597*

FEATURES

Low Cost
Operates with Type J (AD596) or Type K (AD597) Thermocouples
Built-In Ice Point Compensation
Temperature Proportional Operation – 10 mV/°C
Temperature Setpoint Operation – ON/OFF
Programmable Switching Hysteresis
High Impedance Differential Input

GENERAL DESCRIPTION

The AD596/AD597 is a monolithic temperature setpoint controller that has been optimized for use at elevated temperatures such as those found in oven control applications. The device cold junction compensates and amplifies a type J or K thermocouple input to derive an internal signal proportional to temperature. The internal signal is then compared with an externally applied setpoint voltage to yield a low impedance switched output voltage. Dead-Band or switching hysteresis can be programmed using a single external resistor. Alternately, the AD596/AD597 can be configured to provide a voltage output (10 mV/°C) directly from a type J or K thermocouple signal. It can also be used as a stand-alone voltage output temperature sensor.

The AD596/AD597 can be powered with a single supply from +5 V to +30 V, or dual supplies up to a total span of 36 V. Typical quiescent supply current is 160 μA, which minimizes self-heating errors.

The AD596/AD597 H package option includes a thermocouple failure alarm that indicates an open thermocouple lead when operated in the temperature proportional measurement mode. The alarm output has a flexible format which can be used to drive relays, LEDs or TTL logic.

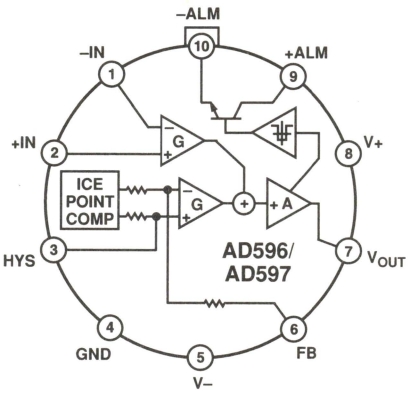
The device is packaged in a reliability qualified, cost effective 10-pin metal can or SOIC and is trimmed to operate over an ambient temperature range from +25°C to +100°C. Operation over an extended ambient temperature range is possible with slightly reduced accuracy. The AD596 will amplify thermocouple signals covering the entire –200°C to +760°C temperature range recommended for type J thermocouples while the AD597 can accommodate –200°C to +1250°C type K inputs.

The AD596/AD597 has a calibration accuracy of ±4°C at an ambient temperature of 60°C and an ambient temperature stability specification of 0.05°C/°C from +25°C to +100°C. If higher accuracy, or a lower ambient operating temperature is required, either the AD594 (J thermocouple) or AD595 (K thermocouple) should be considered.

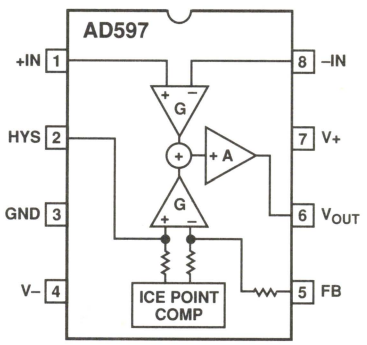
***Protected by U.S. Patent No. 4,029,974.**

FUNCTIONAL BLOCK DIAGRAM

TO-100



SOIC



TOP VIEW
(Not to Scale)

PRODUCT HIGHLIGHTS

1. The AD596/AD597 provides cold junction compensation and a high gain amplifier which can be used as a setpoint comparator.
2. The input stage of the AD596/AD597 is a high quality instrumentation amplifier that allows the thermocouple to float over most of the supply voltage range.
3. Linearization not required for thermocouple temperatures close to 175°C (+100°C to +540°C for AD596).
4. Cold junction compensation is optimized for ambient temperatures ranging from +25°C to +100°C.
5. In the stand-alone mode, the AD596/AD597 produces an output voltage that indicates its own temperature.

REV. B

Voltage Output Temperature Sensor with Signal Conditioning

AD22100*

FEATURES

200°C Temperature Span
Accuracy Better than ±2% of Full Scale
Linearity Better than ±1% of Full Scale
Temperature Coefficient of 22.5 mV/°C
Output Proportional to Temperature × V+
Single Supply Operation
Reverse Voltage Protection
Minimal Self Heating
High Level, Low Impedance Output

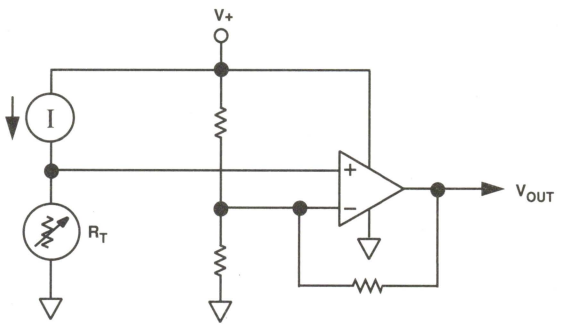
APPLICATIONS

HVAC Systems
System Temperature Compensation
Board Level Temperature Sensing
Electronic Thermostats

MARKETS

Industrial Process Control
Instrumentation
Automotive

SIMPLIFIED BLOCK DIAGRAM



GENERAL DESCRIPTION

The AD22100 is a monolithic temperature sensor with on-chip signal conditioning. It can be operated over the temperature range –50°C to +150°C, making it ideal for use in numerous HVAC, instrumentation and automotive applications.

The signal conditioning eliminates the need for any trimming, buffering or linearization circuitry, greatly simplifying the system design and reducing the overall system cost.

The output voltage is proportional to the temperature times the supply voltage (ratiometric). The output swings from 0.25 V at –50°C to +4.75 V at +150°C using a single +5.0 V supply.

Due to its ratiometric nature, the AD22100 offers a cost effective solution when interfacing to an analog-to-digital converter. This is accomplished by using the ADC's +5 V power supply as a reference to both the ADC and the AD22100 (See Figure 1), eliminating the need for and cost of a precision reference.

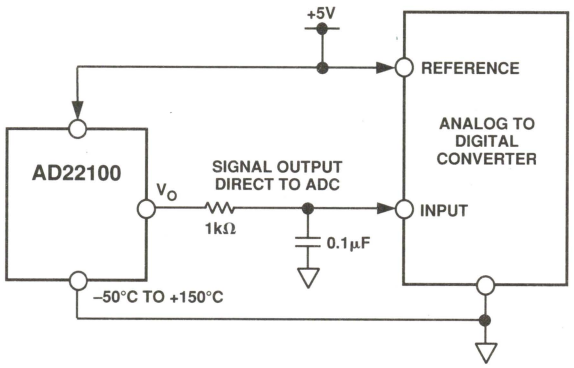


Figure 1. Application Circuit

*Protected by U.S. Patent Nos. 5030849 and 5243319.

REV. B

7

3.3 V Supply, Voltage Output Temperature Sensor with Signal Conditioning

AD22103*

FEATURES

3.3 V, Single Supply Operation
Temperature Coefficient of 28 mV/°C
1008C Temperature Span (0°C to +100°C)
Accuracy Better Than 2.5% of Full Scale
Linearity Better Than 0.5% of Full Scale
Output Proportional to Temperature × V_S
Minimal Self-Heating
High Level, Low Impedance Output
Reverse Supply Protected

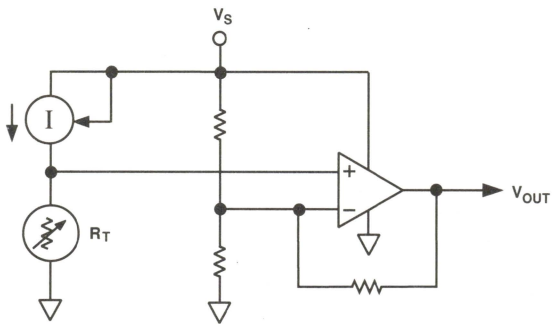
APPLICATIONS

Microprocessor Thermal Management
Battery and Low Powered Systems
Power Supply Temperature Monitoring
System Temperature Compensation
Board Level Temperature Sensing

MARKETS

Computers
Portable Electronic Equipment
Industrial Process Control
Instrumentation

SIMPLIFIED BLOCK DIAGRAM



GENERAL DESCRIPTION

The AD22103 is a monolithic temperature sensor with on-chip signal conditioning. It can be operated over the temperature range 0°C to +100°C, making it ideal for use in numerous 3.3 V applications.

The signal conditioning eliminates the need for any trimming, buffering or linearization circuitry, greatly simplifying the system design and reducing the overall system cost.

The output voltage is proportional to the temperature times the supply voltage (ratiometric). The output swings from 0.25 V at 0°C to +3.05 V at +100°C using a single +3.3 V supply.

Due to its ratiometric nature, the AD22103 offers a cost effective solution when interfacing to an analog-to-digital converter. This is accomplished by using the ADC's power supply as a reference to both the ADC and the AD22103 (see Figure 1), eliminating the need for and cost of a precision reference.

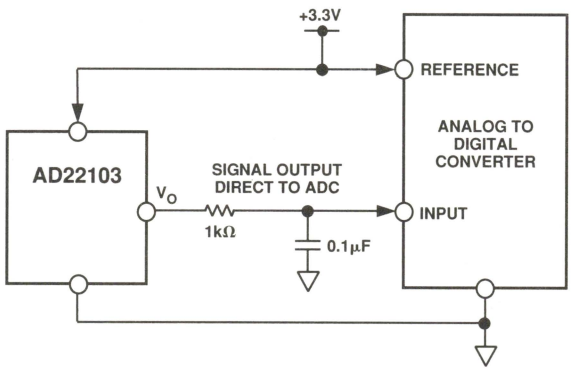


Figure 1. Application Circuit

*Protected by U.S. Patent Nos. 5030849 and 5243319.

REV. 0

7

Low Voltage, Resistor Programmable Thermostatic Switch

AD22105

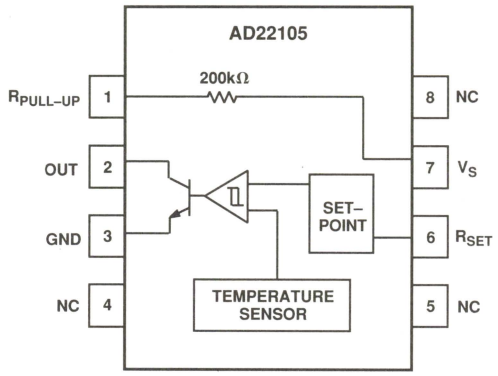
FEATURES

User-Programmable Temperature Setpoint
2.0°C Setpoint Accuracy
4.0°C Preset Hysteresis
Wide Supply Range (+2.7 V dc to +7.0 V dc)
Wide Temperature Range (–40°C to +150°C)
Low Power Dissipation (230 mW @ 3.3 V)

APPLICATIONS

Industrial Process Control
Thermal Control Systems
CPU Monitoring (i.e., Pentium)
Computer Thermal Management Circuits
Fan Control
Hand-Held/Portable Electronic Equipment

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The AD22105 is a solid state thermostatic switch. Requiring only one external programming resistor, the AD22105 can be set to switch accurately at any temperature in the wide operating range of –40°C to +150°C. Using a novel circuit architecture, the AD22105 asserts an open collector output when the ambient temperature exceeds the user-programmed setpoint temperature. The AD22105 has approximately 4°C of hysteresis which prevents rapid thermal on/off cycling.

The AD22105 is designed to operate on a single power supply voltage from +2.7 V to +7.0 V facilitating operation in battery powered applications as well as in industrial control systems. Because of low power dissipation (230 µW @ 3.3 V), self-heating errors are minimized and battery life is maximized.

An optional internal 200 kΩ pull-up resistor is included to facilitate driving light loads such as CMOS inputs.

Alternatively, a low power LED indicator may be driven directly.

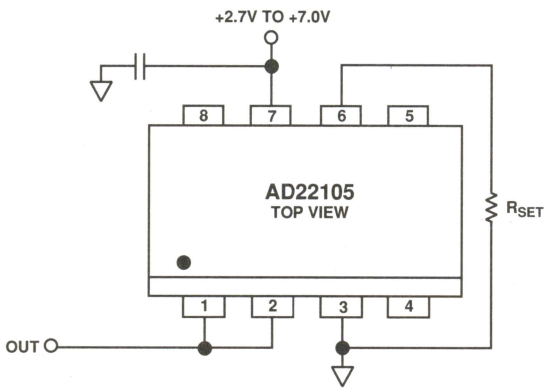


Figure 1. Typical Application Circuit

7

REV. 0

Low Power 10-Bit On-Chip Temperature Sensor

AD7416

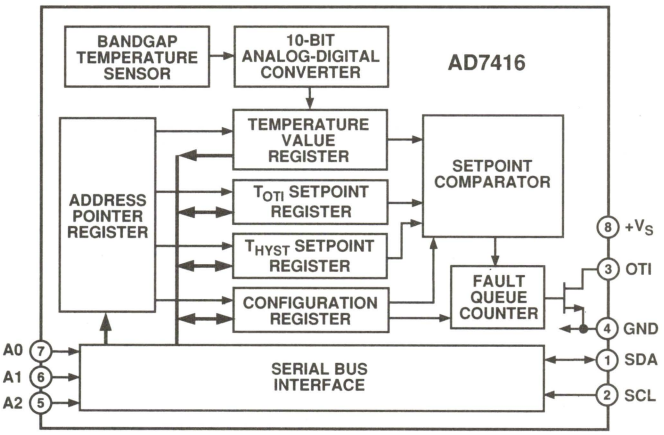
FEATURES

10-Bit Temperature-to-Digital Converter
Open-Drain Over Temperature Shutdown Output Can Be Wire ANDed
I²C® Compatible Serial Interface
Selectable Serial Bus Address Allows Connection of Up to Eight AD7416s to a Single Bus
Low Power Shutdown Mode (1 μA typ)
Space Saving SO-8 Package
Superior Replacement for LM75
335 μs Update Rate

APPLICATIONS

Personal Computers
Electronic Test Equipment
Office Equipment
Domestic Appliances
Process Control

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The AD7416 is a complete temperature monitoring system on a single chip. It contains a bandgap temperature sensor and 10-bit ADC to monitor and digitize the temperature reading to a resolution of 0.25°C, and a setpoint comparator to compare the measured temperature to programmed limits. On-chip registers can be programmed with high and low temperature limits, and an open drain Over Temperature Indicator (OTI) output is provided, which becomes active when a programmed limit is exceeded.

A configuration register allows programming of the sense of the OTI output (active high or active low) and its operating mode (Comparator or Interrupt). A programmable fault queue counter allows the number of out-of-limit measurements that must occur before triggering the OTI output to be set, to prevent spurious triggering of the OTI output in noisy environments.

An I²C-compatible serial interface allows the AD7416 registers to be written to and read back. The three LSBs of the AD7416's serial bus address can be selected, which allows up to eight AD7416s to be connected to a single bus.

The AD7416's wide supply voltage range (2.7 V to 5.5 V) low supply current (0.25 mA typ) and I²C-compatible interface, make it ideal for a variety of applications, including personal computers, office equipment and domestic appliances.

The part is available in an 8-lead SO-8 package.

PRODUCT HIGHLIGHTS

1. The AD7416 has an on-chip temperature sensor that allows an accurate measurement of the ambient temperature to be made. It contains a 10-bit ADC that digitizes the temperature to a 0.25°C resolution. It also contains two on-chip registers which allow the temperature to be compared to programmable high and low limits; an Over Temperature Indicator output is provided to recognize when this occurs. The measurable temperature range is –55°C to +125°C.
2. Wide supply voltage range of 2.7 V to 5.5 V and a low supply current of typically, 0.25 mA.
3. The AD7416 has an automatic power-down feature allowing superior power performance. At slower throughput rates the part can be programmed to operate in a low power shutdown mode, allowing further savings in power consumed by the part.
4. Space saving SO-8 packages.
5. I²C-compatible interface.

7

I²C is a registered trademark of Philips Corporation.

REV. 0

Single and 4-Channel, 8 µs, 10-Bit ADC With On-Chip Temperature Sensor

AD7816/AD7817/AD7818

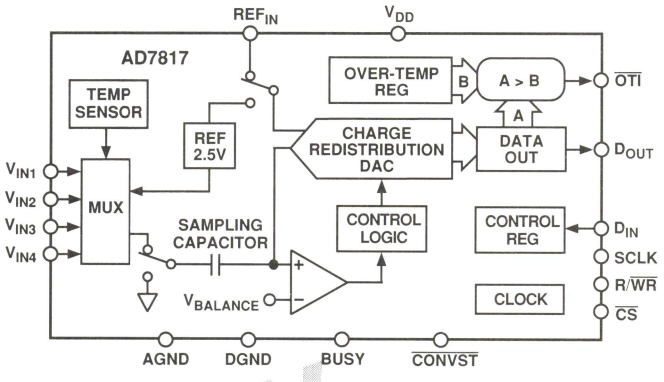
FEATURES

10-Bit ADC with 8 µs Conversion Time
One and Four Single-Ended Analog Input Channels
The AD7816 Is a Temperature Measurement Only Device
On-Chip Temperature Sensor
Resolution of 0.25°C
±1°C Error from –40°C to +85°C
Wide Operating Supply Range
2.7 V to 5.5 V
Inherent Track-and-Hold Functionality
On-Chip Reference (2.5 V ± 0.1%)
Over-Temperature Indicator
Automatic Power-Down at the End of a Conversion
Low Power Operation
4 µW at a Throughput Rate of 10 SPS
40 µW at a Throughput Rate of 1 kSPS
400 µW at a Throughput Rate of 10 kSPS
Flexible Serial Interface
Three-Wire Operation, Allows Easy Interfacing to Most Microcontrollers, Intel 8051, Motorola SPI, National MICRO-WIRE

APPLICATIONS

Ambient Temperature Monitoring (AD7816)
Thermostat and Fan Control
High Speed Microprocessor
Temperature Measurement and Control
Data Acquisition Systems with Ambient Temperature Monitoring (AD7817 and AD7818)
Industrial Process Control
Automotive
Battery Charging Applications

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The AD7818 and AD7817 are 10-bit, single and four channel A/D converters with on-chip temperature sensor that can operate from a single 2.7 V to 5.5 V power supply. The devices contains an 8 µs successive-approximation converter based around a capacitor DAC, an on-chip temperature sensor with an accuracy of ±1°C, an on-chip clock oscillator, inherent track-and-hold functionality and an on-chip reference (2.5 V ± 0.1%). The AD7816 is a temperature monitoring only device in a microSOIC package.

The on-chip temperature sensor of the AD7817 and AD7818 can be accessed via Channel 0. When Channel 0 is selected and a conversion is initiated, the resulting ADC code at the end of the conversion gives a measurement of the ambient temperature with a resolution of ±0.25°C. See Measuring Temperature section of the data sheet.

The AD7816, AD7817 and AD7818 have a flexible serial interface that allows easy interfacing to most microcontrollers. The interface is compatible with the Intel 8051, Motorola SPI and QSPI protocols and National Semiconductors MICRO-WIRE protocol. For more information refer to the Serial Interface section of this data sheet.

The parts are available in a narrow body 0.15" 16-lead Small Outline IC (SOIC), in a 16-lead, Thin Shrink Small Outline Package (TSSOP), an 8-lead Small Outline IC (SOIC) and an 8-lead microsmall Outline (µSOIC).

PRODUCT HIGHLIGHTS

1. The devices have an on-chip temperature sensor that allows an accurate measurement of the ambient temperature to be made. The measurable temperature range is –40°C to +85°C.
2. An over-temperature indicator is implemented by carrying out a digital comparison of the ADC code for Channel 0 (temperature sensor) with the contents of the on-chip over-temperature register. The over-temperature indicator pin goes logic low when a predetermined temperature is exceeded
3. The automatic power-down feature enables the AD7816, AD7817 and AD7818 to achieve superior power performance at slower throughput rates, e.g., 40 µW at 1 kSPS throughput rate.

REV. 0

Low Voltage SOT-23 Temperature Sensors

ADT45/ADT50

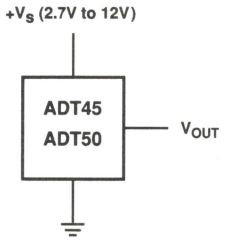
FEATURES

Low Voltage Operation (2.7 V to 12 V)
Calibrated Directly in °C
10 mV/°C Scale Factor
±2°C Accuracy Over Temperature (typ)
±0.5°C Linearity (typ)
Stable with Large Capacitive Loads
Specified –40°C to +125°C, Operation to +150°C
Less than 60 mA Quiescent Current
Low Self-Heating

APPLICATIONS

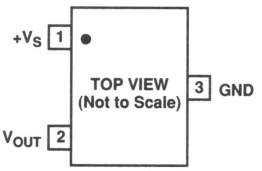
Environmental Control Systems
Thermal Protection
Industrial Process Control
Fire Alarms
Power System Monitors
CPU Thermal Management

FUNCTIONAL BLOCK DIAGRAM



PACKAGE TYPES AVAILABLE

SOT-23



GENERAL DESCRIPTION

The ADT45 and ADT50 are low voltage, precision centigrade temperature sensors. They provide a voltage output that is linearly proportional to the Celsius (Centigrade) temperature. The ADT45/ADT50 do not require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the –40°C to +125°C temperature range. The low output impedance of the ADT45/ADT50, linear output and precise calibration simplify interfacing to temperature control circuitry and A/D converters. All three devices are intended for single supply operation from 2.7 V to 12 V maximum. Supply current runs well below 60 μA providing very low self-heating—less than 0.1°C in still air. The ADT45/ADT50 are functionally and pin compatible with LM45/LM50 respectively. The ADT45 provides a 250 mV output at +25°C and reads temperature from 0°C to +100°C. The ADT50 is specified from –40°C to +125°C, provides a 750 mV output at +25°C and operates to +125°C from a single 2.7 V supply. Both the ADT45 and ADT50 have an output scale factor of +10 mV/°C. Operation extends to +150°C with reduced accuracy for all devices when operating from a 12 V supply.

The ADT45/ADT50 are available in the low cost 3-lead SOT-23 surface mount package.

REV. 0

PRTD Conditioning Circuit and Temperature Controller

ADT70*

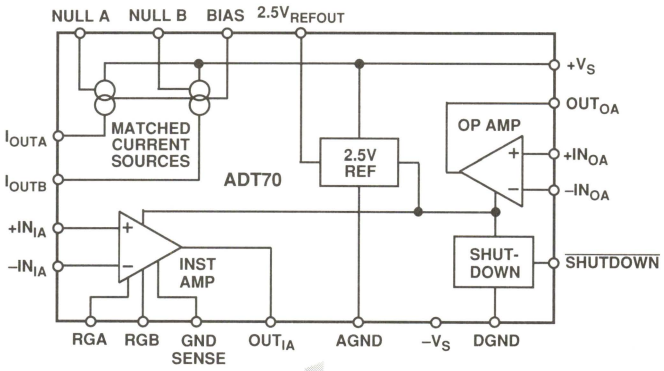
FEATURES

PRTD Temperature Measurement Range
Typically IC Measurement Error ±0.1°C
Includes Two Matched Current Sources
Rail-to-Rail Output Instrumentation Amp
Uncommitted, Rail-to-Rail Output, Op Amp
On-Board +2.5 V Reference
Temperature Coefficient ±25 ppm/°C
+5 V or ±5 V Operation
Supply Current 4 mA max
10 μA max in Shutdown

APPLICATIONS

Temperature Controllers
Portable Instrumentation
Temperature Acquisition Cards

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADT70 provides excitation and signal conditioning for resistance-temperature devices (RTDs). It is ideally suited for 1 kΩ Platinum RTDs (PRTDs) allowing a very wide range of temperature measurement. It can also easily interface to 100 Ω PRTDs. Using a remote, low-cost thin-film, PRTD the ADT70 can measure temperature in the range of –50°C to +500°C. With high-performance platinum elements the temperature change can be extended to 1000°C. Accuracy of the ADT70 and PRTD system over a –200°C to +1000°C temperature range depends heavily on the quality of the PRTD. Typically the ADT70 will introduce an error of only ±0.1°C over the transducer's temperature range, and the error may be trimmed to zero at a single calibration point.

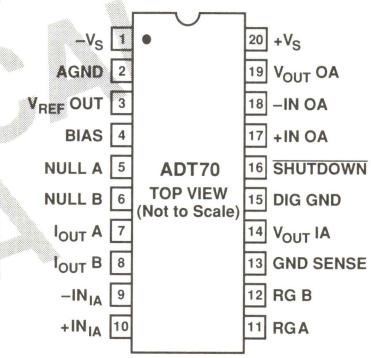
The ADT70 consists of two matched 1 mA (nominal) current sources for transducer and reference resistor excitation, a precision rail-to-rail output instrumentation amplifier, a 2.5 V reference, and an uncommitted rail-to-rail output op amp. The ADT70 includes a shutdown function for battery powered equipment that reduces the quiescent current from 4 mA to less than 10 μA. The ADT70 operates from either single +5 V or ±5 V supplies. Gain or full-scale range for the PRTD and ADT70 system is set by a precision external resistor connected to the instrumentation amplifier. The uncommitted op amp may be used for scaling the internal voltage reference, providing a "PRTD open" signal or "over-temperature" warning, providing a heater switching signal, or other external conditioning determined by the user.

The ADT70 is specified for operation from –40°C to +125°C and is available in 20-pin DIP and SO packages.

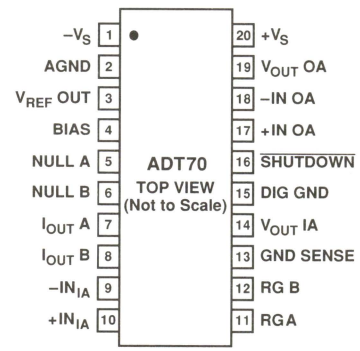
*Patent pending.

PACKAGE TYPES AVAILABLE

20-Lead P-DIP (N Suffix)



20-Lead SOIC (R Suffix)



7

REV. 0

Low Power, Programmable Temperature Controller

TMP01*

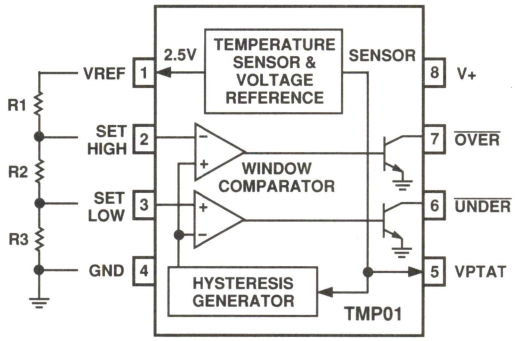
FEATURES

–55°C to +125°C (–67°F to +257°F) Operation
±1.0°C Accuracy Over Temperature (typ)
Temperature-Proportional Voltage Output
User Programmable Temperature Trip Points
User Programmable Hysteresis
20 mA Open Collector Trip Point Outputs
TTL/CMOS Compatible
Single-Supply Operation (4.5 V to 13.2 V)
Low Cost 8-Pin DIP and SO Packages

APPLICATIONS

Over/Under Temperature Sensor and Alarm
Board Level Temperature Sensing
Temperature Controllers
Electronic Thermostats
Thermal Protection
HVAC Systems
Industrial Process Control
Remote Sensors

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The TMP01 is a temperature sensor which generates a voltage output proportional to absolute temperature and a control signal from one of two outputs when the device is either above or below a specific temperature range. Both the high/low temperature trip points and hysteresis (overshoot) band are determined by user-selected external resistors. For high volume production, these resistors are available on-board.

The TMP01 consists of a bandgap voltage reference combined with a pair of matched comparators. The reference provides both a constant 2.5 V output and a voltage proportional to absolute temperature (VPTAT) which has a precise temperature coefficient of 5 mV/K and is 1.49 V (nominal) at +25°C. The comparators compare VPTAT with the externally set temperature trip points and generate an open-collector output signal when one of their respective thresholds has been exceeded.

Hysteresis is also programmed by the external resistor chain and is determined by the total current drawn out of the 2.5 V reference. This current is mirrored and used to generate a hysteresis offset voltage of the appropriate polarity after a comparator has been tripped. The comparators are connected in parallel, which guarantees that there is no hysteresis overlap and eliminates erratic transitions between adjacent trip zones.

The TMP01 utilizes proprietary thin-film resistors in conjunction with production laser trimming to maintain a temperature accuracy of ±1°C (typ) over the rated temperature range, with excellent linearity. The open-collector outputs are capable of sinking 20 mA, enabling the TMP01 to drive control relays directly. Operating from a +5 V supply, quiescent current is only 500 μA (max).

The TMP01 is available in the low cost 8-pin epoxy mini-DIP and SO (small outline) packages, and in die form.

*Protected by U.S. Patent No. 5,195,827.

REV. C

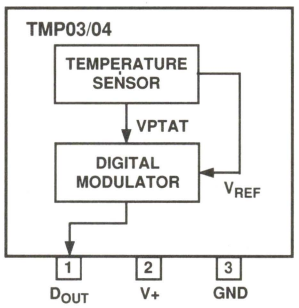
Serial Digital Output Thermometers

TMP03/TMP04*

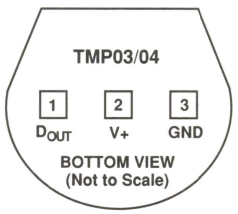
FEATURES
Low Cost 3-Pin Package
Modulated Serial Digital Output
Proportional to Temperature
±1.5°C Accuracy (typ) from –25°C to +100°C
Specified –40°C to +100°C, Operation to 150°C
Power Consumption 6.5 mW Max at 5 V
Flexible Open-Collector Output on TMP03
CMOS/TTL Compatible Output on TMP04
Low Voltage Operation (4.5 V to 7 V)

APPLICATIONS
Isolated Sensors
Environmental Control Systems
Computer Thermal Monitoring
Thermal Protection
Industrial Process Control
Power System Monitors

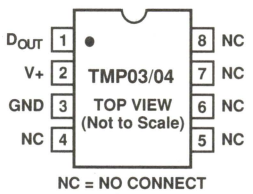
FUNCTIONAL BLOCK DIAGRAM



PACKAGE TYPES AVAILABLE
TO-92



SO-8 AND RU-8 (TSSOP)



GENERAL DESCRIPTION

The TMP03/TMP04 is a monolithic temperature detector that generates a modulated serial digital output that varies in direct proportion to the temperature of the device. An onboard sensor generates a voltage precisely proportional to absolute temperature which is compared to an internal voltage reference and input to a precision digital modulator. The ratiometric encoding format of the serial digital output is independent of the clock drift errors common to most serial modulation techniques such as voltage-to-frequency converters. Overall accuracy is ±1.5°C (typical) from –25°C to +100°C, with excellent transducer linearity. The digital output of the TMP04 is CMOS/TTL compatible, and is easily interfaced to the serial inputs of most popular micro-processors. The open-collector output of the TMP03 is capable of sinking 5 mA. The TMP03 is best suited for systems requiring isolated circuits utilizing optocouplers or isolation transformers.

The TMP03 and TMP04 are specified for operation at supply voltages from 4.5 V to 7 V. Operating from +5 V, supply current (unloaded) is less than 1.3 mA.

The TMP03/TMP04 are rated for operation over the –40°C to +100°C temperature range in the low cost TO-92, SO-8, and TSSOP-8 surface mount packages. Operation extends to +150°C with reduced accuracy.

***Patent pending.**

REV. 0

ANALOG DEVICES

Airflow and Temperature Sensor

TMP12*

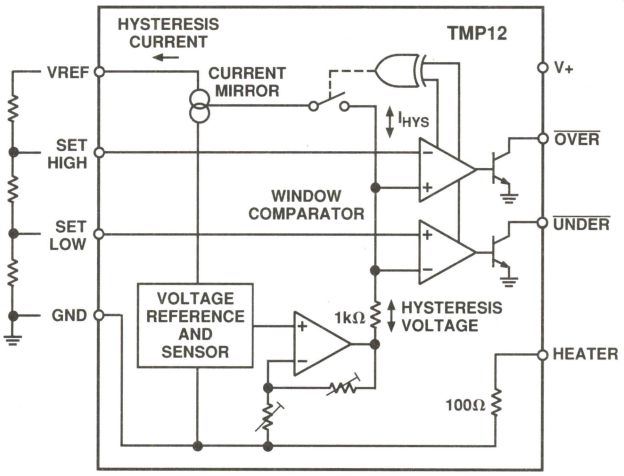
FEATURES

Temperature Sensor Includes 100 Ω Heater
Heater Provides Power IC Emulation
Accuracy ±3°C typ. from −40°C to +100°C
Operation to +150°C
5 mV/°C Internal Scale-Factor
Resistor Programmable Temperature Setpoints
20 mA Open-Collector Setpoint Outputs
Programmable Thermal Hysteresis
Internal 2.5 V Reference
Single 5 V Operation
400 μA Quiescent Current (Heater OFF)
Minimal External Components

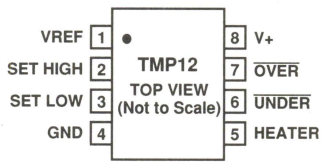
APPLICATIONS

System Airflow Sensor
Equipment Over-Temperature Sensor
Over-Temperature Protection
Power Supply Thermal Sensor
Low-Cost Fan Controller

FUNCTIONAL BLOCK DIAGRAM



PINOUTS
DIP and SO



GENERAL DESCRIPTION

The TMP12 is a silicon-based airflow and temperature sensor designed to be placed in the same airstream as heat generating components that require cooling. Fan cooling may be required continuously, or during peak power demands, e.g. for a power supply, and if the cooling systems fails, system reliability and/or safety may be impaired. By monitoring temperature while emulating a power IC, the TMP12 can provide a warning of cooling system failure.

The TMP12 generates an internal voltage that is linearly proportional to Celsius (Centigrade) temperature, nominally +5 mV/°C. The linearized output is compared with voltages from an external resistive divider connected to the TMP12's 2.5 V precision reference. The divider sets up one or two reference voltages, as required by the user, providing one or two temperature setpoints. Comparator outputs are open-collector transistors able to sink over 20 mA. There is an on-board hysteresis generator provided to speed up the temperature-setpoint output transitions, this also reduces erratic output transitions in noisy environments. Hysteresis is programmed by the external resistor chain and is determined by the total current drawn from the 2.5 V reference. The TMP12 airflow sensor also incorporates a precision, low temperature coefficient 100 Ω heater resistor that may be connected directly to an external 5 V supply.

When the heater is activated it raises the die temperature in the DIP package approximately 20°C above ambient (in still air). The purpose of the heater in the TMP12 is to emulate a power IC, such as a regulator or Pentium CPU which has a high internal dissipation.

When subjected to a fast airflow, the package and die temperatures of the power device and the TMP12 (if located in the same airstream) will be reduced by an amount proportional to the rate of airflow. The internal temperature rise of the TMP12 may be reduced by placing a resistor in series with the heater, or reducing the heater voltage.

The TMP12 is intended for single 5 V supply operation, but will operate on a 12 V supply. The heater is designed to operate from 5 V only. Specified temperature range is from –40°C to +125°C, operation extends to +150°C at 5 V with reduced accuracy.

The TMP12 is available in 8-pin plastic DIP and SO packages.

*Protected by U.S. Patent No. 5,195,827.

REV. 0

Low Cost, Current Output Temperature Transducer

TMP17*

FEATURES

Operating Temperature Range: −40°C to +105°C
Single Supply Operation: +4 V to +30 V
Excellent Repeatability and Stability
High Level Output: 1 μA/K
Monolithic IC: Temperature In/Current Out
Minimal Self-Heating Errors

APPLICATIONS

Appliance Temperature Sensor
Automotive Temperature Measurement and Control
HVAC System Monitoring
Industrial Temperature Control
Thermocouple Cold Junction Compensation

GENERAL DESCRIPTION

The TMP17 is a monolithic integrated circuit temperature transducer that provides an output current proportional to absolute temperature. For a wide range of supply voltages the transducer acts as a high impedance temperature dependent current source of 1 μA/K. Improved design and laser wafer trimming of the IC's thin-film resistors allows the TMP17 to achieve absolute accuracy levels and nonlinearity errors previously unattainable at a comparable price.

The TMP17 can be employed in applications between −40°C to +105°C where conventional temperature sensors (i.e., thermistor, RTD, thermocouple, diode) are currently being used. Expensive linearization circuitry, precision voltage references, bridge components, resistance measuring circuitry and cold junction compensation are not required with the TMP17.

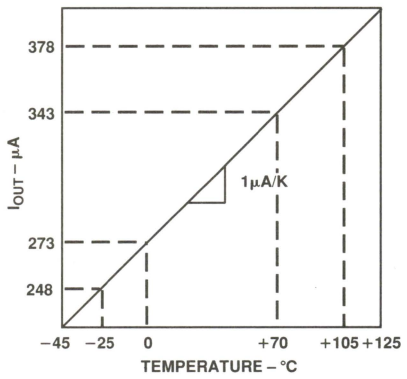
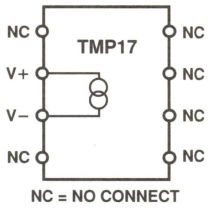


Figure 1. Transfer Characteristic

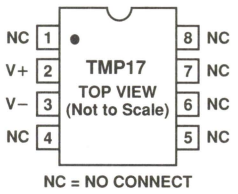
*Protected by U.S. Patent No. 4,123,698.

FUNCTIONAL BLOCK DIAGRAM



PACKAGE DIAGRAM

SO-8



The TMP17 is available in a low cost SO-8 surface-mount package.

PRODUCT HIGHLIGHTS

1. A wide operating temperature range (−40°C to +105°C) and highly linear output make the TMP17 an ideal substitute for older, more limited sensor technologies (i.e., thermistors, RTDs, diodes, thermocouples).
2. The TMP17 is electrically rugged; supply irregularities and variations or reverse voltages up to 20 V will not damage the device.
3. Because the TMP17 is a temperature dependent current source, it is immune to voltage noise pickup and IR drops in the signal leads when used remotely.
4. The high output impedance of the TMP17 provides greater than 0.5°C/V rejection of supply voltage drift and ripple.
5. Laser wafer trimming and temperature testing insures that TMP17 units are easily interchangeable.
6. Initial system accuracy will not degrade significantly over time. The TMP17 has proven long term performance and repeatability advantages inherent in integrated circuit design and construction.

7

REV. 0

Low Voltage Temperature Sensors

TMP35/TMP36/TMP37

FEATURES

Low Voltage Operation (+2.7 V to +5.5 V)
Calibrated Directly in °C
10 mV/°C Scale Factor (20 mV/°C on TMP37)
±2°C Accuracy Over Temperature (typ)
±0.5°C Linearity (typ)
Stable with Large Capacitive Loads
Specified –40°C to +125°C, Operation to +150°C
Less than 50 μA Quiescent Current
Shutdown Current 0.5 μA max
Low Self-Heating

APPLICATIONS

Environmental Control Systems
Thermal Protection
Industrial Process Control
Fire Alarms
Power System Monitors
CPU Thermal Management

PRODUCT DESCRIPTION

The TMP35, TMP36 and TMP37 are low voltage, precision centigrade temperature sensors. They provide a voltage output that is linearly proportional to the Celsius (Centigrade) temperature. The TMP35/TMP36/TMP37 do not require any external calibration to provide typical accuracies of ±1°C at +25°C and ±2°C over the –40°C to +125°C temperature range.

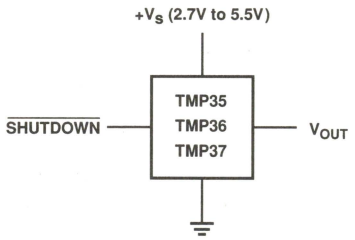
The low output impedance of the TMP35/TMP36/TMP37, and its linear output and precise calibration simplify interfacing to temperature control circuitry and A/D converters. All three devices are intended for single-supply operation from 2.7 V to 5.5 V maximum. Supply current runs well below 50 μA providing very low self-heating—less than 0.1°C in still air. In addition, a shutdown function is provided to cut supply current to less than 0.5 μA.

The TMP35 is functionally compatible with the LM35/LM45 and provides a 250 mV output at +25°C. The TMP35 reads temperatures from +10°C to +125°C. The TMP36 is specified from –40°C to +125°C, provides a 750 mV output at +25°C and operates to +125°C from a single 2.7 V supply. The TMP36 is functionally compatible with the LM50. Both the TMP35 and TMP36 have an output scale factor of +10 mV/°C. The TMP37 is intended for applications over the range +5°C to +100°C, and provides an output scale factor of 20 mV/°C. The TMP37 provides a 500 mV output at +25°C. Operation extends to +150°C with reduced accuracy for all devices when operating from a 5 V supply.

The TMP35/TMP36/TMP37 are all available in low cost 3-pin TO-92, and SO-8 and 5-pin SOT-23 surface mount packages.

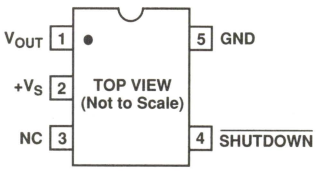
REV. A

FUNCTIONAL BLOCK DIAGRAM



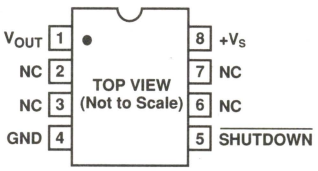
PACKAGE TYPES AVAILABLE

RT-5 (SOT-23)



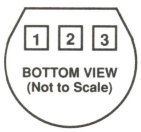
NC = NO CONNECT

SO-8



NC = NO CONNECT

TO-92



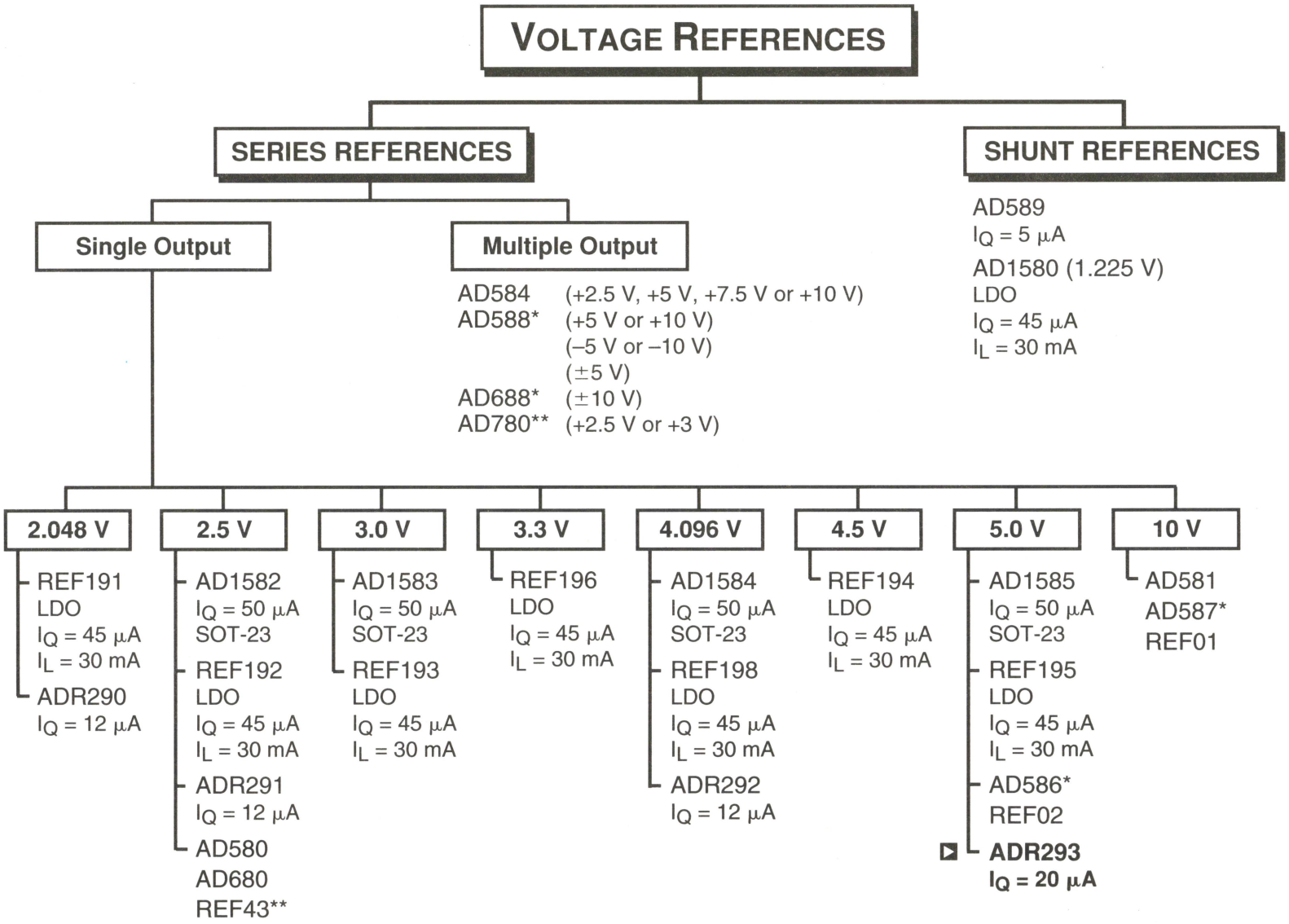
PIN 1 - +VS, PIN 2 - VOUT, PIN 3 - GND

7

VOLTAGE REFERENCES

Series and Shunt References

8



*Buried Zener

**With Temperature Output

▶ = New Product since *1997 Short Form Designers' Guide.*

VOLTAGE REFERENCES

Model	Nominal Output Voltage Volts	Initial Calibration mV	Ref Drift ppm/°C	Noise 0.1 Hz to 10 Hz µV p-p	Long Term Stability/ 1000 Hrs µV	I_Q mA	I_{OUT} mA	# Pins	Lowest Grade Price 100s	Comments	Fax-code
Series References											
AD1582	+2.5	2 to 20	50 to 100	30	TBD	50 µA	5	3	$ 0.85	Series Mode, LDO	2125
AD1583	+3.0	3 to 30	50 to 100	30	TBD	50 µA	5	3	$ 0.85	Series Mode, LDO	2125
AD1584	+4.096	4 to 40	50 to 100	30	TBD	50 µA	5	3	$ 0.85	Series Mode, LDO	2125
AD1585	+5.0	5 to 50	50 to 100	30	TBD	50 µA	5	3	$ 0.85	Series Mode, LDO	2125
Shunt References											
AD589	+1.235	15	10 to 100	5	NS	50 µA	NA	2	$ 1.47	Two Terminal Shunt Reg	1185
AD1580	+1.225	1 to 10	50 to 100	5	NS	50 µA	NA	3	$ 0.85	Two Terminal Shunt Reg	1963
Fixed Output											
AD580J	+2.5	10 to 75	10 to 85	60	250	2	10	3	$ 2.36	Header Package Only	1176
AD680J	+2.5	50 to 100	20 to 25	10	63	0.250	10	8	$ 3.25	Low Power	1231
REF43	+2.5	5 to 30	10 to 25	10	1 ppm/Mon	0.6	20	8/20	$ 3.75		1762
AD780	+2.5 or 3.0	1 to 5	3 to 7	4	20	1	±10	8	$ 3.90	Very Low Noise	1355
AD586	+5.0	2 to 25	2 to 20	4	75	3	±10	8	$ 2.65	Can Be Used at –5 V	1182
REF02	+5.0	5 to 100	8.5 to 250	1	NS	1.4	10	8	$ 1.65	On-Chip Temp Sensor	1756
AD581	+10.0	5 to 30	5 to 30	50	250	1	10	3	$ 3.62	Header Package Only	1177
AD587	+10.0	5 to 10	5 to 20	4	150	4	±10	8	$ 2.60	Can Be Used at –10 V	1183
REF01	+10.0	30 to 100	8.5 to 65	30	NS	1.4	10	8	$ 2.59	Industry Standard	1755
AD688	±10	2, 5	3, 6	6	15	12	10	16	$14.66		1234
xFET References											
ADR290	+2.048	2 to 6	5 to 25	10	0.2 ppm	10 µA	5	3/8	$ 2.42	Low Power, Low Hysteresis	2110
ADR291	+2.50	2 to 6	5 to 25	10	0.2 ppm	12 µA	5	3/8	$ 2.42	Low Power, Low Hysteresis	2110
ADR292	+4.096	2 to 6	5 to 25	10	0.2 ppm	12 µA	5	3/8	$ 2.42	Low Power, Low Hysteresis	2110
▶ **ADR293**	**+5.0**	**3 to 5**	**8 to 25**	**12**	**0.2 ppm**	**20 µA**	**5**	**3/8**	**$ 2.42**	**Low Power, Low Hysteresis**	**2255**

▶ = New Product since *1997 Short Form Designers' Guide.*

VOLTAGE REFERENCES

Precision References with Low Dropout

Model	Nominal Output Voltage Volts	Initial Calibration mV	Ref Drift ppm/°C	Noise 0.1 Hz to 10 Hz µV p-p	Long Term Stability/ 1000 Hrs µV	I_Q mA	I_{OUT} mA	# Pins	Lowest Grade Price 100s	Comments	Fax-code
REF191	+2.048	2 to 10	5 to 25	50	NS	45 µA	30	8	$3.60	High I_{OUT}	1761
REF192	+2.5	2 to 10	5 to 25	50	NS	45 µA	30	8	$3.60	High I_{OUT}	1761
REF193	+3.0	10	25	50	NS	45 µA	30	8	$1.49	High I_{OUT}	1761
REF196	+3.3	10	25	50	NS	45 µA	30	8	$2.20	High I_{OUT}	1761
REF198	+4.096	2 to 10	4 to 8	50	NS	45 µA	30	8	$2.20	High I_{OUT}	1761
REF194	+4.5	2 to 10	5 to 25	50	NS	45 µA	30	8	$2.20	High I_{OUT}	1761
REF195	+5.0	2 to 10	5 to 25	50	NS	45 µA	30	8	$1.40	High I_{OUT}	1761

Selectable Output

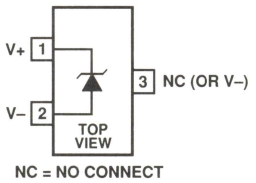
Model	# of Buffer Amps	Output Voltage Option Volts	Initial Calibration Error ±mV	PPM Grades ppm	Tracking Error ±mV	Noise 0.1 Hz to 10 Hz µV p-p	Long Term Stability/ 1000 Hrs ppm	I_Q mA	I_{OUT} mA	# Pins	Lowest Grade Price 100s	Fax-code
AD584	1	+10	5 to 30	15, 30	NA	50	25	1	10	8	$4.10	1180
AD584		+7.5	4 to 20	15, 30	NA	50	25	1	10	8	$4.10	1180
AD584		+5	3 to 15	15, 30	NA	50	25	1	10	8	$4.10	1180
AD584		+2.5	2.5 to 7.5	15, 30	NA	50	25	1	10	8	$4.10	1180
AD588	2	+10	5	1.5, 3, 4, 6	NS	6	15	10	10	16	$6.82	1184
AD588		+5	5	1.5, 3, 4, 6	NS	6	15	10	10	16	$6.82	1184
AD588		±5	5	1.5, 3, 4, 6	1.5	6	15	10	10	16	$6.82	1184
AD588		–5	5	1.5, 3, 4, 6	NS	6	15	10	10	16	$6.82	1184
AD588		–10	5	1.5, 3, 4, 6	NS	6	15	10	10	16	$6.82	1184

1.2 V Micropower, Precision Shunt Voltage Reference

AD1580

FEATURES
Wide Operating Range: 50 μA–10 mA
Initial Accuracy: ±0.1% max
Temperature Drift: ±50 ppm/°C max
Output Impedance: 0.5 Ω max
Wideband Noise (10 Hz–10 kHz): 20 μV rms
Operating Temperature Range: –40°C to +85°C
High ESD Rating
4 kV Human Body Model
400 V Machine Model
Compact, Surface-Mount, SOT-23 Package

PIN CONFIGURATION
SOT-23 PACKAGE



NC = NO CONNECT

GENERAL DESCRIPTION

The AD1580 is a low cost, two-terminal (shunt), precision bandgap reference. It provides an accurate 1.225 V output for input currents between 50 μA and 10 mA.

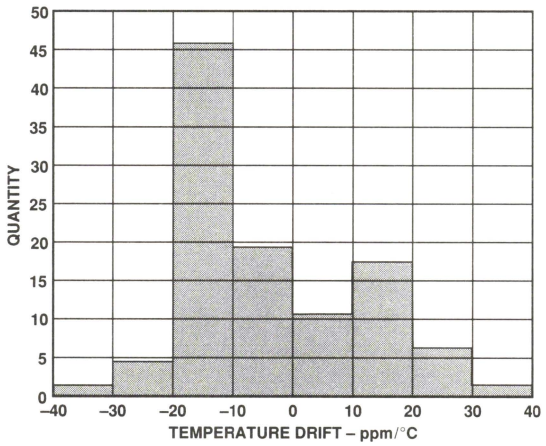
The AD1580's superior accuracy and stability is made possible by the precise matching and thermal tracking of on-chip components. Proprietary curvature correction design techniques have been used to minimize the nonlinearities in the voltage output temperature characteristics. The AD1580 is stable with any value of capacitive load.

The low minimum operating current makes the AD1580 ideal for use in battery powered 3 V or 5 V systems. However, the wide operating current range means that the AD1580 is extremely versatile and suitable for use in a wide variety of high current applications.

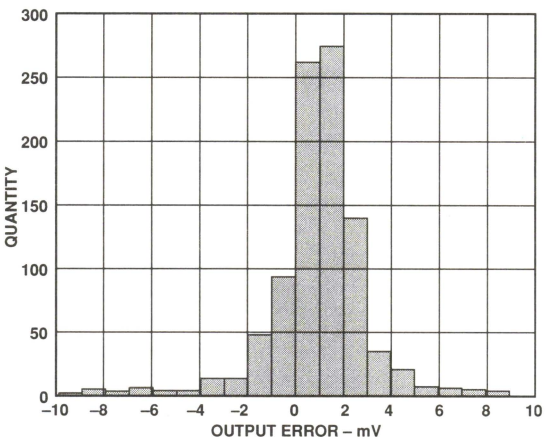
The AD1580 is available in two grades, A and B, both of which are provided in an SOT-23 package, the smallest surface mount package available on the market. Both grades are specified over the industrial temperature range of –40°C to +85°C.

TARGET APPLICATIONS

1. Portable, Battery-Powered Equipment:
   Cellular Phones, Notebook Computers, PDAs, GPS and DMM.
2. Computer Workstations
   Suitable for use with a wide range of video RAMDACs.
3. Smart Industrial Transmitters
4. PCMCIA Cards.
5. Automotive.
6. 3 V/5 V 8–12-Bit Data Converters.



Reverse Voltage Temperature Drift Distribution



Reverse Voltage Error Distribution

8

REV. 0

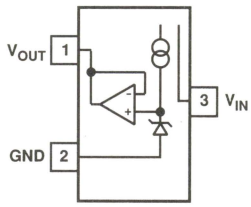
2.5 V to 5.0 V Micropower, Precision Series Mode Voltage References

AD1582/AD1583/AD1584/AD1585

FEATURES

Series Reference (2.5 V, 3 V, 4.096 V, 5 V)
Initial Accuracy: ±0.1% max
Temperature Drift: ±50 ppm/°C max
Low Quiescent Current: 65 μA max
Current Output Capability: ±5 mA
Wide Supply Range: V_{IN} = V_{OUT} + 200 mV to 12 V
Wideband Noise (10 Hz–10 kHz): 50 μV rms
Operating Temperature Range: –40°C to +85°C
Compact, Surface-Mount, SOT-23 Package

FUNCTIONAL BLOCK DIAGRAMS



AD1582/3/4/5
TOP VIEW

GENERAL DESCRIPTION

The AD1582, AD1583, AD1584 and AD1585 are a family of low cost, low power, low dropout, precision bandgap references. These designs are available as three-terminal (series) devices and are packaged in the compact SOT-23, 3-pin, surface mount package. The versatility of these references makes them ideal for use in battery powered 3 V or 5 V systems where there may be wide variations in supply voltage and a need to minimize power dissipation.

The superior accuracy and temperature stability of the AD1582/AD1583/AD1584/AD1585 is made possible by the precise matching and thermal tracking of on-chip components. Patented temperature drift curvature correction design techniques have been used to minimize the nonlinearities in the voltage output temperature characteristic.

These series mode devices (AD1582/AD1583/AD1584/AD1585) will source or sink up to 5 mA of load current and operate efficiently with only 200 mV of required headroom. This family will draw a maximum 65 μA of quiescent current with only a 1.0 μA/V variation with supply voltage. The advantage of these designs over conventional shunt devices is extraordinary. Valuable supply current is no longer wasted through an input series resistor and maximum power efficiency is achieved at all input voltage levels.

The AD1582, AD1583, AD1584 and AD1585 are available in two grades, A and B, both of which are provided in the smallest available package on the market, the SOT-23. Both grades are specified over the industrial temperature range of –40°C to +85°C.

TARGET APPLICATIONS

1. Portable, Battery Powered Equipment. Notebook Computers, Cellular Phones, Pagers, PDAs, GPSs and DMMs.
2. Computer Workstations. Suitable for use with a wide range of video RAMDACs.
3. Smart Industrial Transmitters.
4. PCMCIA Cards.
5. Automotive.
6. Hard Disk Drives.
7. 3 V/5 V 8-Bit–12-Bit Data Converters.

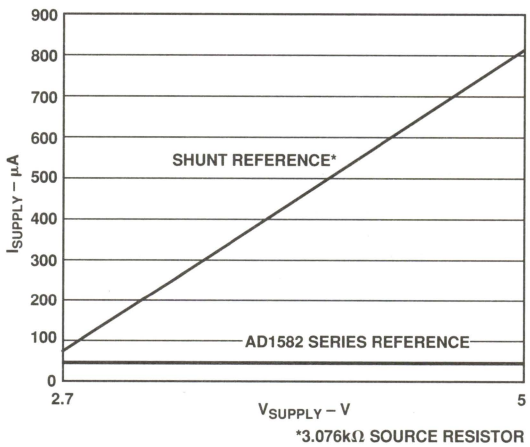


Figure 1. Supply Current (μA) vs. Supply Voltage (V)

8

REV. 0

ANALOG DEVICES

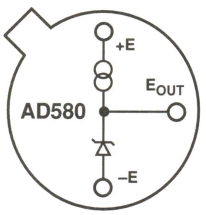
High Precision 2.5 V IC Reference

AD580*

FEATURES

Laser Trimmed to High Accuracy: 2.500 V ± 0.4%
3-Terminal Device: Voltage In/Voltage Out
Excellent Temperature Stability: 10 ppm/°C (AD580M, U)
Excellent Long-Term Stability: 250 μV (25 μV/Month)
Low Quiescent Current: 1.5 mA max
Small, Hermetic IC Package: TO-52 Can
MIL-STD-883 Compliant Versions Available

FUNCTIONAL BLOCK DIAGRAM



TO-52
BOTTOM VIEW

PRODUCT DESCRIPTION

The AD580 is a three-terminal, low cost, temperature compensated, bandgap voltage reference which provides a fixed 2.5 V output for inputs between 4.5 V and 30 V. A unique combination of advanced circuit design and laser-wafer trimmed thin-film resistors provide the AD580 with an initial tolerance of ±0.4%, a temperature stability of better than 10 ppm/°C and long-term stability of better than 250 μV. In addition, the low quiescent current drain of 1.5 mA max offers a clear advantage over classical Zener techniques.

The AD580 is recommended as a stable reference for all 8-, 10- and 12-bit D-to-A converters that require an external reference. In addition, the wide input range of the AD580 allows operation with 5 volt logic supplies making the AD580 ideal for digital panel meter applications or whenever only a single logic power supply is available.

The AD580J, K, L and M are specified for operation over the 0°C to +70°C temperature range; the AD580S, T and U are specified for operation over the extended temperature range of –55°C to +125°C.

PRODUCT HIGHLIGHTS

1. Laser-trimming of the thin-film resistors minimizes the AD580 output error. For example, the AD580L output tolerance is ±10 mV.
2. The three-terminal voltage in/voltage out operation of the AD580 provides regulated output voltage without any external components.
3. The AD580 provides a stable 2.5 V output voltage for input voltages between 4.5 V and 30 V. The capability to provide a stable output voltage using a 5-volt input makes the AD580 an ideal choice for systems that contain a single logic power supply.
4. Thin-film resistor technology and tightly controlled bipolar processing provide the AD580 with temperature stabilities to 10 ppm/°C and long-term stability better than 250 μV.
5. The low quiescent current drain of the AD580 makes it ideal for CMOS and other low power applications.
6. The AD580 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD580/883B data sheet for detailed specifications.

*Protected by Patent Nos. 3,887,863; RE30,586.

REV. A

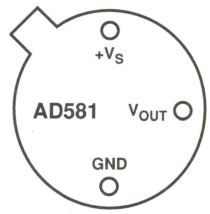
High Precision 10 V IC Reference

AD581*

FEATURES

Laser Trimmed to High Accuracy:
10.000 Volts ±5 mV (L and U)
Trimmed Temperature Coefficient:
5 ppm/°C max, 0°C to +70°C (L)
10 ppm/°C max, –55°C to +125°C (U)
Excellent Long-Term Stability:
25 ppm/1000 hrs. (Noncumulative)
Negative 10 Volt Reference Capability
Low Quiescent Current: 1.0 mA max
10 mA Current Output Capability
3-Terminal TO-5 Package
MIL-STD-883 Compliant Versions Available

FUNCTIONAL BLOCK DIAGRAM



TO-5
BOTTOM VIEW

PRODUCT DESCRIPTION

The AD581 is a three-terminal, temperature compensated, monolithic bandgap voltage reference which provides a precise 10.00 volt output from an unregulated input level from 12 to 30 volts. Laser Wafer Trimming (LWT) is used to trim both the initial error at +25°C as well as the temperature coefficient, which results in high precision performance previously available only in expensive hybrids or oven-regulated modules. The 5 mV initial error tolerance and 5 ppm/°C guaranteed temperature coefficient of the AD581L represent the best performance combination available in a monolithic voltage reference.

The bandgap circuit design used in the AD581 offers several advantages over classical Zener breakdown diode techniques. Most important, no external components are required to achieve full accuracy and stability of significance to low power systems. In addition, total supply current to the device, including the output buffer amplifier (which can supply up to 10 mA) is typically 750 μA. The long-term stability of the bandgap design is equivalent or superior to selected Zener reference diodes.

The AD581 is recommended for use as a reference for 8-, 10- or 12-bit D/A converters which require an external precision reference. The device is also ideal for all types of A/D converters up to 14-bit accuracy, either successive approximation or integrating designs, and in general can offer better performance than that provided by standard self-contained references.

The AD581J, K, and L are specified for operation from 0°C to +70°C; the AD581S, T, and U are specified for the –55°C to +125°C range. All grades are packaged in a hermetically sealed three-terminal TO-5 metal can.

*Covered by Patent Nos. 3,887,863; RE 30,586.

PRODUCT HIGHLIGHTS

1. Laser trimming of both initial accuracy and temperature coefficient results in very low errors over temperature without the use of external components. The AD581L has a maximum deviation from 10.000 volts of ±7.25 mV from 0°C to +70°C, while the AD581U guarantees ±15 mV maximum total error without external trims from –55°C to +125°C.
2. Since the laser trimming is done on the wafer prior to separation into individual chips, the AD581 will be extremely valuable to hybrid designers for its ease of use, lack of required external trims, and inherent high performance.
3. The AD581 can also be operated in a two-terminal "Zener" mode to provide a precision negative 10 volt reference with just one external resistor to the unregulated supply. The performance in this mode is nearly equal to that of the standard three-terminal configuration.
4. Advanced circuit design using the bandgap concept allows the AD581 to give full performance with an unregulated input voltage down to 13 volts. With an external resistor, the device will operate with a supply as low as 11.4 volts.
5. The AD581 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD581/883B data sheet for detailed specifications.

REV. A

Pin Programmable Precision Voltage Reference

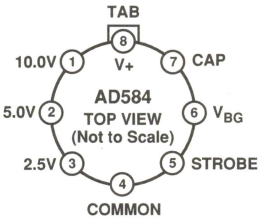
AD584*

FEATURES

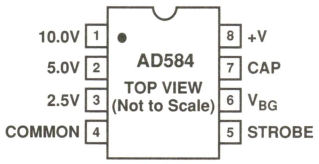
Four Programmable Output Voltages:
10.000 V, 7.500 V, 5.000 V, 2.500 V
Laser-Trimmed to High Accuracies
No External Components Required
Trimmed Temperature Coefficient:
5 ppm/°C max, 0°C to +70°C (AD584L)
5 ppm/°C max, –55°C to +125°C (AD584T)
Zero Output Strobe Terminal Provided
Two Terminal Negative Reference Capability (5 V & Above)
Output Sources or Sinks Current
Low Quiescent Current: 1.0 mA max
10 mA Current Output Capability
MIL-STD-883 Compliant Versions Available

PIN CONFIGURATIONS

8-Pin TO-99



8-Pin DIP



GENERAL DESCRIPTION

The AD584 is an eight-terminal precision voltage reference offering pin-programmable selection of four popular output voltages: 10.000 V, 7.500 V, 5.000 V and 2.500 V. Other output voltages, above, below or between the four standard outputs, are available by the addition of external resistors. Input voltage may vary between 4.5 and 30 volts.

Laser Wafer Trimming (LWT) is used to adjust the pin-programmable output levels and temperature coefficients, resulting in the most flexible high precision voltage reference available in monolithic form.

In addition to the programmable output voltages, the AD584 offers a unique strobe terminal which permits the device to be turned on or off. When the AD584 is used as a power supply reference, the supply can be switched off with a single, low-power signal. In the "off" state the current drain by the AD584 is reduced to about 100 μA. In the "on" state the total supply current is typically 750 μA including the output buffer amplifier.

The AD584 is recommended for use as a reference for 8-, 10- or 12-bit D/A converters which require an external precision reference. The device is also ideal for all types of A/D converters of up to 14-bit accuracy, either successive approximation or integrating designs, and in general can offer better performance than that provided by standard self-contained references.

The AD584J, K and L are specified for operation from 0°C to +70°C; the AD584S and T are specified for the –55°C to +125°C range. All grades are packaged in a hermetically sealed eight-terminal TO-99 metal can; the AD584 J and K are also available in an 8-pin plastic DIP.

*Protected by U.S. Patent No. 3,887,863; RE 30,586

PRODUCT HIGHLIGHTS

1. The flexibility of the AD584 eliminates the need to design-in and inventory several different voltage references. Furthermore one AD584 can serve as several references simultaneously when buffered properly.
2. Laser trimming of both initial accuracy and temperature coefficient results in very low errors over temperature without the use of external components. The AD584LH has a maximum deviation from 10.000 volts of ±7.25 mV from 0°C to +70°C.
3. The AD584 can be operated in a two-terminal "Zener" mode at 5 volts output and above. By connecting the input and the output, the AD584 can be used in this "Zener" configuration as a negative reference.
4. The output of the AD584 is configured to sink or source currents. This means that small reverse currents can be tolerated in circuits using the AD584 without damage to the reference and without disturbing the output voltage (10 V, 7.5 V and 5 V outputs).
5. The AD584 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD584/883B data sheet for detailed specifications.

REV. A

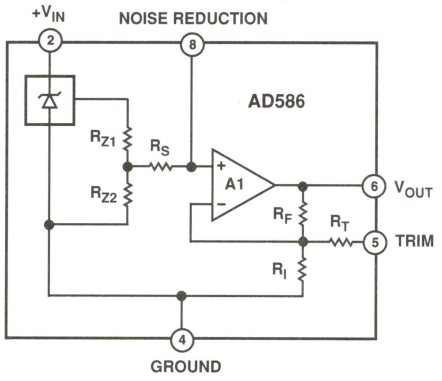
High Precision 5 V Reference

AD586

FEATURES

Laser Trimmed to High Accuracy:
5.000 V ±2.0 mV (M Grade)
Trimmed Temperature Coefficient:
2 ppm/°C max, 0°C to +70°C (M Grade)
5 ppm/°C max, –40°C to +85°C (B & L Grades)
10 ppm/°C max, –55°C to +125°C (T Grade)
Low Noise, 100 nV/$\sqrt{Hz}$
Noise Reduction Capability
Output Trim Capability
MIL-STD-883 Compliant Versions Available
Industrial Temperature Range SOICs Available
Output Capable of Sourcing or Sinking 10 mA

FUNCTIONAL BLOCK DIAGRAM



NOTE: PINS 1, 3 & 7 ARE INTERNAL TEST POINTS.
MAKE NO CONNECTIONS TO THESE POINTS.

PRODUCT DESCRIPTION

The AD586 represents a major advance in the state-of-the-art in monolithic voltage references. Using a proprietary ion-implanted buried Zener diode and laser wafer trimming of high stability thin-film resistors, the AD586 provides outstanding performance at low cost.

The AD586 offers much higher performance than most other 5 V references. Because the AD586 uses an industry standard pinout, many systems can be upgraded instantly with the AD586. The buried Zener approach to reference design provides lower noise and drift than bandgap voltage references. The AD586 offers a noise reduction pin which can be used to further reduce the noise level generated by the buried Zener.

The AD586 is recommended for use as a reference for 8-, 10-, 12-, 14- or 16-bit D/A converters which require an external precision reference. The device is also ideal for successive approximation or integrating A/D converters with up to 14 bits of accuracy and, in general, can offer better performance than the standard on-chip references.

The AD586J, K, L and M are specified for operation from 0°C to +70°C, the AD586A and B are specified for –40°C to +85°C operation, and the AD586S and T are specified for –55°C to +125°C operation. The AD586J, K, L and M are available in an 8-pin plastic DIP. The AD586J, K, L, A and B are available in an 8-pin plastic surface mount small outline (SO) package. The AD586J, K, L, S and T are available in an 8-pin cerdip package.

PRODUCT HIGHLIGHTS

1. Laser trimming of both initial accuracy and temperature coefficients results in very low errors over temperature without the use of external components. The AD586M has a maximum deviation from 5.000 V of ±2.45 mV between 0°C and +70°C, and the AD586T guarantees ±7.5 mV maximum total error between –55°C and +125°C.
2. For applications requiring higher precision, an optional fine-trim connection is provided.
3. Any system using an industry standard pinout reference can be upgraded instantly with the AD586.
4. Output noise of the AD586 is very low, typically 4 μV p-p. A noise reduction pin is provided for additional noise filtering using an external capacitor.
5. The AD586 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD586/883B data sheet for detailed specifications.

8

REV. C

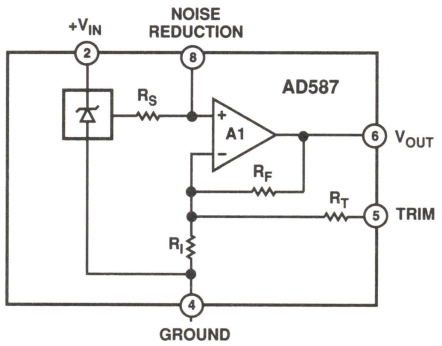
High Precision 10 V Reference

AD587

FEATURES

Laser Trimmed to High Accuracy:
10.000 V ±5 mV (L and U Grades)
Trimmed Temperature Coefficient:
5 ppm/°C max, (L and U Grades)
Noise Reduction Capability
Low Quiescent Current: 4 mA max
Output Trim Capability
MIL-STD-883 Compliant Versions Available

FUNCTIONAL BLOCK DIAGRAM



NOTE: PINS 1, 3 & 7 ARE INTERNAL TEST POINTS.
MAKE NO CONNECTIONS TO THESE POINTS.

PRODUCT DESCRIPTION

The AD587 represents a major advance in the state-of-the-art in monolithic voltage references. Using a proprietary ion-implanted buried Zener diode and laser wafer trimming of high stability thin-film resistors, the AD587 provides outstanding performance at low cost.

The AD587 offers much higher performance than most other 10 V references. Because the AD587 uses an industry standard pinout, many systems can be upgraded instantly with the AD587. The buried Zener approach to reference design provides lower noise and drift than bandgap voltage references. The AD587 offers a noise reduction pin which can be used to further reduce the noise level generated by the buried Zener.

The AD587 is recommended for use as a reference for 8-, 10-, 12-, 14- or 16-bit D/A converters which require an external precision reference. The device is also ideal for successive approximation or integrating A/D converters with up to 14 bits of accuracy and, in general, can offer better performance than the standard on-chip references.

The AD587J, K and L are specified for operation from 0°C to +70°C, and the AD587S, T and U are specified for –55°C to +125°C operation. All grades are available in 8-pin cerdip. The J and K versions are also available in an 8-pin Small Outline IC (SOIC) package for surface mount applications, while the J, K and L grades also come in an 8-pin plastic package.

PRODUCT HIGHLIGHTS

1. Laser trimming of both initial accuracy and temperature coefficients results in very low errors over temperature without the use of external components. The AD587L has a maximum deviation from 10.000 V of ±8.5 mV between 0°C and +70°C, and the AD587U guarantees ±14 mV maximum total error between –55°C and +125°C.
2. For applications requiring higher precision, an optional fine trim connection is provided.
3. Any system using an industry standard pinout 10 volt reference can be upgraded instantly with the AD587.
4. Output noise of the AD587 is very low, typically 4 µV p-p. A noise reduction pin is provided for additional noise filtering using an external capacitor.
5. The AD587 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD587/883B data sheet for detailed specifications.

REV. C

ANALOG DEVICES

High Precision Voltage Reference

AD588*

FEATURES

Low Drift: 1.5 ppm/°C
Low Initial Error: 1 mV
Pin-Programmable Output
+10 V, +5 V, ±5 V Tracking, –5 V, –10 V
Flexible Output Force and Sense Terminals
High Impedance Ground Sense
Machine-Insertable DIP Packaging
MIL-STD-883 Compliant Versions Available

PRODUCT DESCRIPTION

The AD588 represents a major advance in the state-of-the-art in monolithic voltage references. Low initial error and low temperature drift give the AD588 absolute accuracy performance previously not available in monolithic form. The AD588 uses a proprietary ion-implanted buried Zener diode, and laser-wafer-drift trimming of high stability thin-film resistors to provide outstanding performance at low cost.

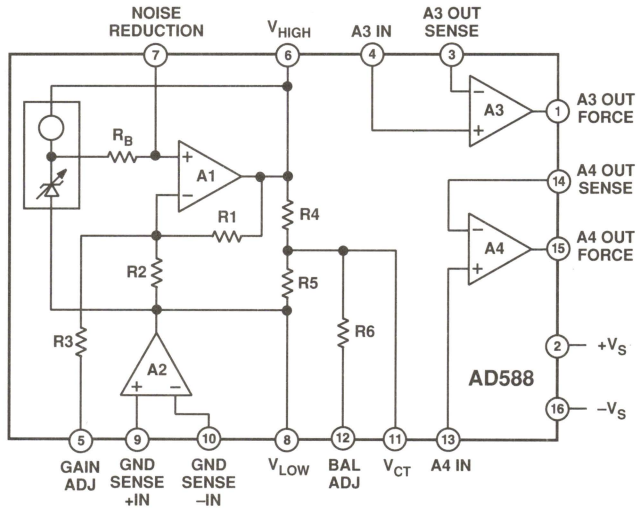
The AD588 includes the basic reference cell and three additional amplifiers which provide pin-programmable output ranges. The amplifiers are laser-trimmed for low offset and low drift to maintain the accuracy of the reference. The amplifiers are configured to allow Kelvin connections to the load and/or boosters for driving long lines or high-current loads, delivering the full accuracy of the AD588 where it is required in the application circuit.

The low initial error allows the AD588 to be used as a system reference in precision measurement applications requiring 12-bit absolute accuracy. In such systems, the AD588 can provide a known voltage for system calibration in software and the low drift allows compensation for the drift of other components in a system. Manual system calibration and the cost of periodic recalibration can therefore be eliminated. Furthermore, the mechanical instability of a trimming potentiometer and the potential for improper calibration can be eliminated by using the AD588 in conjunction autocalibration software.

The AD588 is available in seven versions. The AD588 JQ and KQ grades are packaged in a 16-pin cerdip and are specified for 0°C to +70°C operation. AD588AQ and BQ grades are packaged in a 16-pin cerdip and are specified for the –25°C to +85°C industrial temperature range. The ceramic AD588SQ and TQ grades are specified for the full military/aerospace temperature range. For military surface mount applications, the AD588SE and TE grades are also available in 20-pin LCC packages.

*Covered by Patent Number 4,644,253.

FUNCTIONAL BLOCK DIAGRAM



PRODUCT HIGHLIGHTS

1. The AD588 offers 12-bit absolute accuracy without any user adjustments. Optional fine-trim connections are provided for applications requiring higher precision. The fine-trimming does not alter the operating conditions of the Zener or the buffer amplifiers and thus does not increase the temperature drift.
2. Output noise of the AD588 is very low—typically 6 µV p-p. A pin is provided for additional noise filtering using an external capacitor.
3. A precision ±5 V tracking mode with Kelvin output connections is available with no external components. Tracking error is less than one millivolt and a fine-trim is available for applications requiring exact symmetry between the +5 V and –5 V outputs.
4. Pin strapping capability allows configuration of a wide variety of outputs: ±5 V, +5 V and +10 V, –5 V & –10 V dual outputs or +5 V, –5 V, +10 V, –10 V single outputs.
5. Extensive temperature testing at –55°C, –25°C, 0°C, +25°C, +50°C, +70°C, +85°C and +125°C ensures that the specified temperature coefficient is truly representative of device performance.

8

REV. B

Two Terminal IC 1.2 V Reference

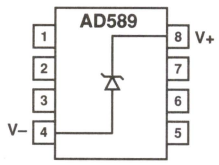
AD589

FEATURES

Superior Replacement for Other 1.2 V References
Wide Operating Range: 50 μA to 5 mA
Low Power: 60 μW Total P_D at 50 μA
Low Temperature Coefficient:
10 ppm/°C max, 0°C to +70°C (AD589M)
25 ppm/°C max, –55°C to +125°C (AD589U)
Two-Terminal "Zener" Operation
Low Output Impedance: 0.6 V
No Frequency Compensation Required
Low Cost
MIL-STD-883 Compliant Versions Available

FUNCTIONAL BLOCK DIAGRAMS

SOIC (SO-8)



TOP VIEW

Metal Can (H-02A)

BOTTOM VIEW

PRODUCT DESCRIPTION

The AD589 is a two-terminal, low cost, temperature compensated bandgap voltage reference which provides a fixed 1.23 V output voltage for input currents between 50 μA and 5.0 mA.

The high stability of the AD589 is primarily dependent upon the matching and thermal tracking of the on-chip components. Analog Devices' precision bipolar processing and thin-film technology combine to provide excellent performance at low cost.

Additionally, the active circuit produces an output impedance ten times lower than typical low-TC Zener diodes. This feature allows operation with no external components required to maintain full accuracy under changing load conditions.

The AD589 is available in seven versions. The AD589J, K, L and M grades are specified for 0°C to +70°C operation, while the S, T, and U grades are rated for the full –55°C to +125°C temperature range. All grades are available in a metal can (H-02A) package. The AD589J is also available in an 8-pin SOIC package.

PRODUCT HIGHLIGHTS

1. The AD589 is a two-terminal device which delivers a constant reference voltage for a wide range of input current.
2. Output impedance of 0.6 Ω and temperature coefficients as low as 10 ppm/°C insure stable output voltage over a wide range of operating conditions.
3. The AD589 can be operated as a positive or negative reference. "Floating" operation is also possible.
4. The AD589 will operate with total current as low as 50 μA (60 μW total power dissipation), ideal for battery powered instrument applications.
5. The AD589 is an exact replacement for other 1.2 V references, offering superior temperature performance and reduced sensitivity to capacitive loading.
6. The AD589 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD589/883B data sheet for detailed specifications.

REV. B

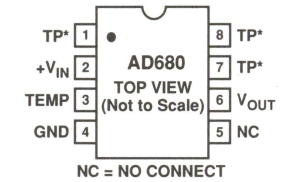
Low Power, Low Cost 2.5 V Reference

AD680*

FEATURES

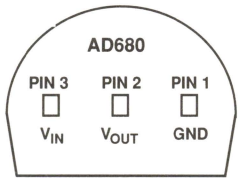
Low Quiescent Current: 250 μA max
Laser Trimmed to High Accuracy:
2.5 V ±5 mV max (AN, AR Grade)
Trimmed Temperature Coefficient:
20 ppm/°C max (AN, AR Grade)
Low Noise: 8 μV p-p from 0.1 Hz to 10 Hz
250 nV/√Hz Wideband
Temperature Output Pin (N, R Packages)
Available in Three Package Styles:
8-Pin Plastic DIP, 8-Pin SOIC and 3-Pin TO-92

CONNECTION DIAGRAMS



NC = NO CONNECT

* TP DENOTES FACTORY TEST POINTS. NO CONNECTIONS SHOULD BE MADE TO THESE PINS.



BOTTOM VIEW

PRODUCT DESCRIPTION

The AD680 is a bandgap voltage reference which provides a fixed 2.5 V output from inputs between 4.5 V and 36 V. The architecture of the AD680 enables the reference to be operated at a very low quiescent current while still realizing excellent dc characteristics and noise performance. Trimming of the high stability thin-film resistors is performed for initial accuracy and temperature coefficient, resulting in low errors over temperature.

The precision dc characteristics of the AD680 make it ideal for use as a reference for D/A converters which require an external precision reference. The device is also ideal for A/D converters and, in general, can offer better performance than the standard on-chip references.

Based upon the low quiescent current of the AD680, which rivals that of many incomplete two-terminal references, the AD680 is recommended for low power applications such as hand-held battery equipment.

A temperature output pin is provided on the 8-pin package versions of the AD680. The temperature output pin provides an output voltage that varies linearly with temperature and allows the AD680 to be configured as a temperature transducer while providing a stable 2.5 V output.

The AD680 is available in five grades. The AD680AN is specified for operation from –40°C to +85°C, while the AD680JN is specified for 0°C to +70°C operation. Both the AD680AN and AD680JN are available in 8-pin plastic DIP packages. The AD680AR is specified for operation from –40°C to +85°C, while the AD680JR is specified for 0°C to +70°C operation. Both are available in an 8-pin Small Outline IC (SOIC) package. The AD680JT is specified for 0°C to +70°C operation and is available in a 3-pin TO-92 package.

*Protected by U.S. Patent Nos. 4,902,959; 4,250,445 and 4,857,862.

PRODUCT HIGHLIGHTS

1. The AD680 bandgap reference operates on a very low quiescent current which rivals that of many two-terminal references. This makes the complete, higher accuracy AD680 ideal for use in power sensitive applications.
2. Laser trimming of both initial accuracy and temperature coefficients results in low errors over temperature without the use of external components. The AD680AN and AD680AR have a maximum variation of 6.25 mV between –40°C and +85°C.
3. The AD680 noise is low, typically 8 μV p-p from 0.1 Hz to 10 Hz. Spectral density is also low, typically 250 nV/√Hz.
4. The temperature output pin on the 8-pin package versions enables the AD680 to be configured as a temperature transducer.
5. Plastic DIP packaging provides machine insertability, while SOIC packaging provides surface mount capability. TO-92 packaging offers a cost effective alternative to two-terminal references, offering a complete solution in the same package in which two-terminal references are usually found.

REV. C

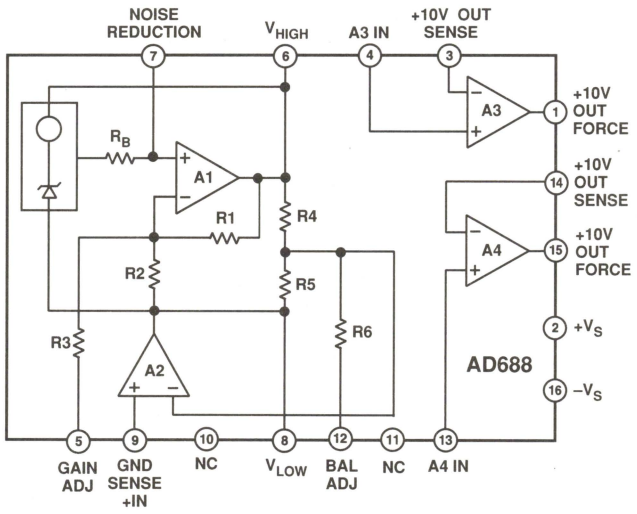
High Precision ±10 V Reference

AD688*

FEATURES

±10 V Tracking Outputs
Kelvin Connections
Low Tracking Error – 1.5 mV
Low Initial Error – 2.0 mV
Low Drift – 1.5 ppm/°C
Low Noise – 6 μV p-p
Flexible Output Force and Sense Terminals
High Impedance Ground Sense
Machine Insertable DIP Packaging
MIL-STD-883 Compliant Versions Available

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD688 is a high precision ±10 V tracking reference. Low tracking error, low initial error and low temperature drift give the AD688 reference absolute ±10 V accuracy performance previously unavailable in monolithic form. The AD688 uses a proprietary ion-implanted buried Zener diode, and laser-wafer-drift-trimming of high stability thin-film resistors to provide outstanding performance at low cost.

The AD688 includes the basic reference cell and three additional amplifiers. The amplifiers are laser-trimmed for low offset and low drift and maintain the accuracy of the reference. The amplifiers are configured to allow Kelvin connections to the load and/or boosters for driving long lines or high current loads, delivering the full accuracy of the AD688 where it is required in the application circuit.

The low initial error allows the AD688 to be used as a system reference in precision measurement applications requiring 12-bit absolute accuracy. In such systems, the AD688 can provide a known voltage for system calibration and the cost of periodic recalibration can therefore be eliminated. Furthermore, the mechanical instability of a trimming potentiometer and the potential for improper calibration can be eliminated by using the AD688 and calibration software.

The AD688 is available in three versions. The AD688AQ and BQ grades are packaged in 16-pin cerdip (0.3") packages and are specified for operation from –40°C to +85°C. The AD688SQ grade is specified for operation from –55°C to +125°C.

*Covered by Patent Number 4,644,253.

PRODUCT HIGHLIGHTS

1. The AD688 offers precision tracking ±10 V Kelvin output connections with no external components. Tracking error is less than 1.5 mV and a fine-trim is available for applications requiring exact symmetry between the +10 V and –10 V outputs.
2. The AD688 offers 12-bit absolute accuracy without any user adjustments. Optional fine-trim connections are provided for applications requiring higher precision. The fine-trimming does not alter the operating conditions of the Zener or the buffer amplifiers and thus does not increase the temperature drift.
3. Output noise of the AD688 is low – typically 6 μV p-p. A pin is provided for broadband noise filtering using an external capacitor.
4. The AD688 is available in versions compliant with MIL-STD-883. Refer to the Analog Devices Military Products Databook or current AD688/883B data sheet for detailed specifications.

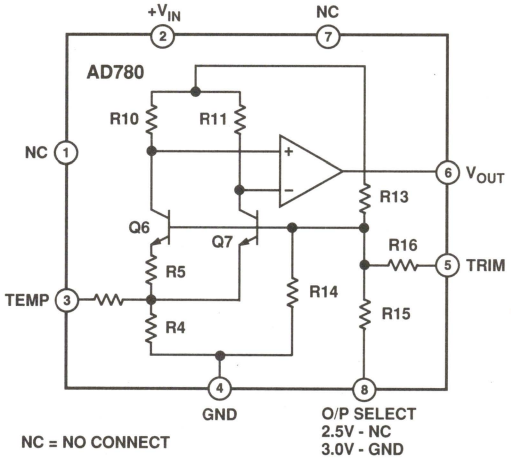
2.5 V/3.0 V High Precision Reference

AD780

FEATURES

Pin-Programmable 2.5 V or 3.0 V Output
Ultralow Drift: 3 ppm/°C max
High Accuracy: 2.5 V or 3.0 V ± 1 mV max
Low Noise: 100 nV/$\sqrt{Hz}$
Noise Reduction Capability
Low Quiescent Current: 1 mA max
Output Trim Capability
Plug-In Upgrade for Present References
Temperature Output Pin
Series or Shunt Mode Operation (±2.5 V, ±3.0 V)

FUNCTIONAL BLOCK DIAGRAM



PRODUCT DESCRIPTION

The AD780 is an ultrahigh precision bandgap reference voltage which provides a 2.5 V or 3.0 V output from inputs between 4.0 V and 36 V. Low initial error and temperature drift combined with low output noise and the ability to drive any value of capacitance make the AD780 the ideal choice for enhancing the performance of high resolution ADCs and DACs and for any general purpose precision reference application. A unique low headroom design facilitates a 3.0 V output from a 5.0 V ± 10% input, providing a 20% boost to the dynamic range of an ADC, over performance with existing 2.5 V references.

The AD780 can be used to source or sink up to 10 mA and can be used in series or shunt mode, thus allowing positive or negative output voltages without external components. This makes it suitable for virtually any high performance reference application. Unlike some competing references, the AD780 has no "region of possible instability." The part is stable under all load conditions when a 1 µF bypass capacitor is used on the supply.

A temperature output pin is provided on the AD780. This provides an output voltage that varies linearly with temperature, allowing the AD780 to be configured as a temperature transducer while providing a stable 2.5 V or 3.0 V output.

The AD780 is a pin-compatible performance upgrade for the LT1019(A)–2.5 and the AD680. The latter is targeted toward low power applications.

The AD780 is available in two grades in plastic DIP, SOIC and cerdip packages. The AD780AN, AD780AR, AD780BN and AD780BR are specified for operation from –40°C to +85°C. The AD780SQ and AD780SQ/883B are specified for –55°C to +125°C operation.

PRODUCT HIGHLIGHTS

1. The AD780 provides a pin-programmable 2.5 V or 3.0 V output from a 4 V to 36 V input.
2. Laser trimming of both initial accuracy and temperature coefficients results in low errors over temperature without the use of external components. The AD780BN has a maximum variation of 0.8 mV from –40°C to +85°C.
3. For applications requiring even higher accuracy, an optional fine-trim connection is provided.
4. The AD780 noise is extremely low, typically 4 µV p-p from 0.1 Hz to 10 Hz and a wideband spectral noise density of typically 100 nV/$\sqrt{Hz}$. This can be further reduced if desired, by simply using two external capacitors.
5. The temperature output pin enables the AD780 to be configured as a temperature transducer while providing a stable output reference voltage.

8

REV. A

Low Noise Micropower Precision Voltage References

ADR290/ADR291/ADR292

FEATURES

Voltage Options 2.048 V, 2.500 V and 4.096 V
2.7 V to 15 V Supply Range
Supply Current 12 μA max
Initial Accuracy ±2 mV max
Temperature Coefficient 8 ppm/°C max
Low-Noise 6 μV p-p (0.1 – 10 Hz)
High Output Current 5 mA min
Temperature Range −40°C to +125°C
REF02/REF19x Pinout

APPLICATIONS

Portable Instrumentation
Precision Reference for 3 V and 5 V Systems
A/D and D/A Converter Reference
Solar Powered Applications
Loop-Current Powered Instruments

GENERAL DESCRIPTION

The ADR290, ADR291 and ADR292 are low noise, micropower precision voltage references that use an XFET™ reference circuit. The new XFET™ architecture offers significant performance improvements over traditional bandgap and Zener-based references. Improvements include: one quarter the voltage noise output of bandgap references operating at the same current, very low and ultralinear temperature drift, low thermal hysteresis and excellent long-term stability.

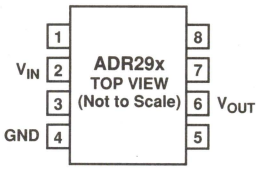
The ADR29x family are series voltage references providing stable and accurate output voltages from supplies as low as 2.7 V. Output voltage options are 2.048 V, 2.5 V and 4.096 V for the ADR290, ADR291 and ADR292 respectively. Quiescent current is only 12 μA, making these devices ideal for battery powered instrumentation. Three electrical grades are available offering initial output accuracies of ±2 mV, ±3 mV and ±6 mV max for the ADR290 and ADR291 and ±3 mV, ±4 mV and ±6 mV max for the ADR292. Temperature coefficients for the three grades are 8 ppm/°C, 15 ppm/°C and 25 ppm/°C max, respectively. Line regulation and load regulation are typically 30 ppm/V and 30 ppm/mA, maintaining the reference's overall high performance. For a device with 5.0 V output, refer to the ADR293 data sheet.

The ADR290, ADR291 and ADR292 references are specified over the extended industrial temperature range of –40°C to +125°C. Devices are available in the 8-lead SOIC, 8-lead TSSOP and the TO-92 package.

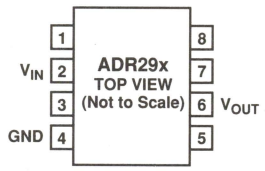
XFET is a trademark of Analog Devices, Inc.

PIN CONFIGURATIONS

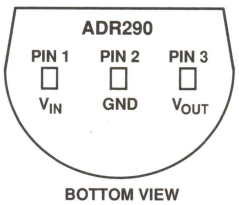
8-Lead Narrow Body SO (R Suffix)



8-Lead TSSOP (RU Suffix)



3-Pin TO-92 (T9 Suffix)



Part Number	Nominal Output Voltage (V)
ADR290	2.048
ADR291	2.500
ADR292	4.096

8

REV. 0

Low Noise Micropower Precision Voltage Reference

ADR293

FEATURES

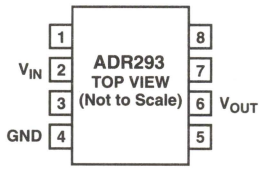
Voltage Output 5.0 V
5.5 V to 15 V Supply Range
Supply Current 20 μA max
Initial Accuracy ±3 mV max
Temperature Coefficient 8 ppm/°C max
Low-Noise 12 μV p-p (0.1 Hz–10 Hz)
High Output Current 5 mA min
Temperature Range −40°C to +125°C
REF02/REF19x Pinout

APPLICATIONS

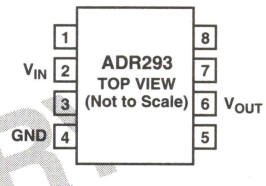
Portable Instrumentation
Precision Reference for 5 V Systems
A/D and D/A Converter Reference
Solar Powered Applications
Loop-Current Powered Instruments

PIN CONFIGURATIONS

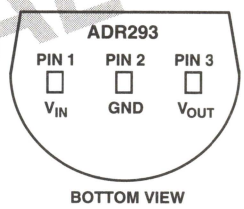
8-Lead Narrow Body SO (R Suffix)



8-Lead TSSOP (RU Suffix)



3-Pin TO-92 (T9 Suffix)



GENERAL DESCRIPTION

The ADR293 is a low noise, micropower precision voltage reference that utilize an XFET™ reference circuit. The new XFET™ architecture offers significant performance improvements over traditional bandgap and Zener-based references. Improvements include: one quarter the voltage noise output of bandgap references operating at the same current, very low and ultralinear temperature drift, low thermal hysteresis and excellent long-term stability.

The AD293 is a series voltage references providing stable and accurate output voltage from a 5.5 V supply. Quiescent current is only 20 μA, making this device ideal for battery powered instrumentation. Three electrical grades are available offering initial output accuracies of ±3 mV, ±4 mV and ±6 mV. Temperature coefficients for the three grades are 8 ppm/°C, 15 ppm/°C and 25 ppm/°C max. Line regulation and load regulation are typically 30 ppm/V and 30 ppm/mA, maintaining the reference's overall high performance.

The ADR293 is specified over the extended industrial temperature range of –40°C to +125°C. This device is available in the 8-lead SOIC, 8-lead TSSOP and the TO-92 package.

Part Number	Nominal Output Voltage (V)
ADR290	2.048
ADR291	2.500
ADR292	4.096
ADR293	5.000

} See Separate Data Sheet

8

XFET is a trademark of Analog Devices, Inc.

REV. 0

+10 V Precision Voltage Reference

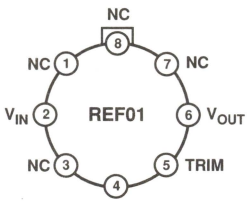
REF01

FEATURES

10 Volt Output: ±0.3%
Adjustment Range: ±3%
Excellent Temperature Stability: 3 ppm/°C
Low Noise: 20 mV p-p
Low Supply Current: 1.4 mA max
Wide Input Voltage Range: 13 V to 33 V
High Load-Driving Capability: 20 mA
No External Components
Short-Circuit Proof
MIL-STD-883 Screening Available

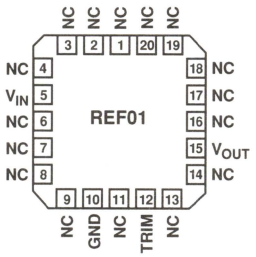
PIN CONNECTIONS

TO-99
(J Suffix)



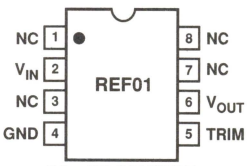
NC = NO CONNECT

20-Terminal LCC
(RC Suffix)



NC = NO CONNECT

Epoxy Mini-DIP (P Suffix)
8-Pin Hermetic DIP (Z Suffix)
8-Pin SO (S Suffix)



NC = NO CONNECT

GENERAL DESCRIPTION

The REF01 precision voltage reference provides a stable +10 V output which can be adjusted over at ±3% range with minimal effect on temperature stability. Single-supply operation over an input voltage range of 12 V to 40 V, low current drain of 1 mA, and excellent temperature stability are achieved with an improved bandgap design. Low cost, low noise, and low power make the REF01 an excellent choice whenever a stable voltage reference is required. Applications include D/A and A/D converters, portable instrumentation, and digital voltmeters. Full military temperature range devices with screening to MIL-STD-883 are available. For guaranteed long-term drift see the REF10 data sheet.

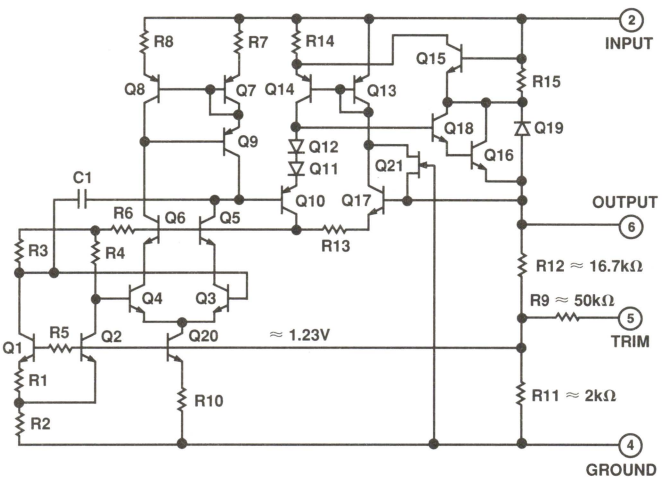


Figure 1. Simplified Schematic

ORDERING GUIDE[1]

Model	DV_O max (T_A = +258C)	Temperature Range	Package Option
REF01AJ[2]	±30 mV	–55°C to +125°C	TO-99
REF01AZ[2]	±30 mV	–55°C to +125°C	8-Pin Cerdip
REF01EJ	±30 mV	0°C to +70°C	TO-99
REF01EZ	±30 mV	0°C to +70°C	8-Pin Cerdip
REF01J[3]	±50 mV	–55°C to +125°C	TO-99
REF01HJ	±50 mV	0°C to +70°C	TO-99
REF01HZ	±50 mV	0°C to +70°C	8-Pin Cerdip
REF01HP	±50 mV	0°C to +70°C	8-Pin Plastic DIP
REF01CJ	±100 mV	0°C to +70°C	TO-99
REF01CZ	±100 mV	0°C to +70°C	8-Pin Cerdip
REF01CP	±100 mV	–40°C to +85°C	8-Pin Plastic DIP
REF01CP	±100 mV	–40°C to +85°C	8-Pin Plastic DIP
REF01CS	±100 mV	–40°C to +85°C	8-Pin SO
REF01RC /883	±50 mV	–55°C to +125°C	20-Pin LCC

NOTES
[1]All commercial and industrial temperature range parts are available with burn-in per MIL-STD-883.
[2]Also available with MIL-STD-883 processing. To order add/883 as a suffix to the part number.

8

REV. B

+5 V Precision Voltage Reference/Temperature Transducer

REF02

FEATURES

5 Volt Output: ±0.3% max
Temperature Voltage Output: 2.1 mV/°C
Adjustment Range: ±3% min
Excellent Temperature Stability: 8.5 ppm/°C max
Low Noise: 15 μV p-p max
Low Supply Current: 1.4 mA max
Wide Input Voltage Range: 7 V to 40 V
High Load-Driving Capacity: 20 mA
No External Components
Short-Circuit Proof
MIL-STD-883 Screening Available
Available in Die Form

GENERAL DESCRIPTION

The REF02 precision voltage reference provides a stable +5 V output which can be adjusted over a ±6% range with minimal effect on temperature stability. Single-supply operation over an input voltage range of 7 V to 40 V, low current drain of 1 mA, and excellent temperature stability are achieved with an improved bandgap design. Low cost, low noise, and low power make the REF02 an excellent choice whenever a stable voltage reference is required. Applications include D/A and A/D converters, portable instrumentation, and digital voltmeters. The versatility of the REF02 is enhanced by its use as a monolithic temperature transducer. For +10 V references, see the REF01 and REF10 data sheets.

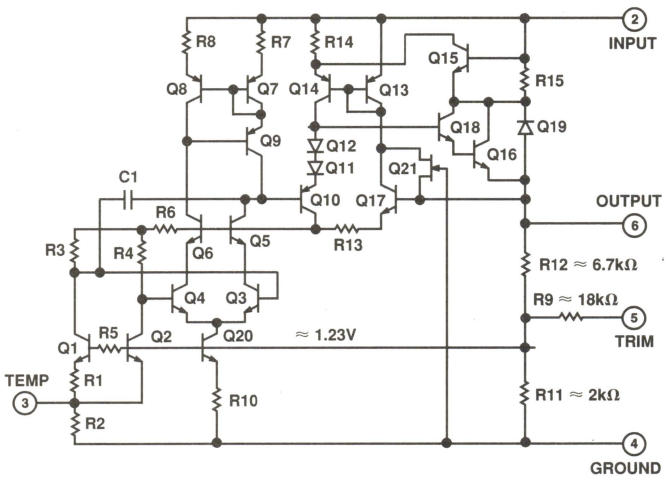
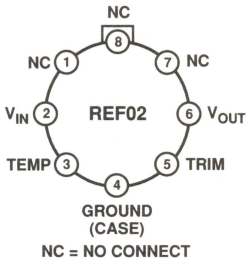


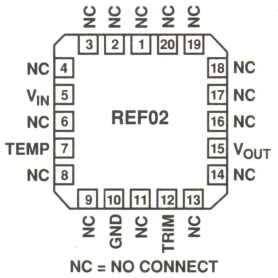
Figure 1. Simplified Schematic

PIN CONNECTIONS

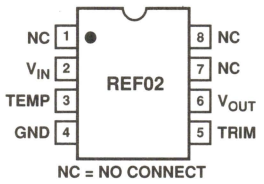
TO-99
(J Suffix)



REF02RC/883 LCC
(RC Suffix)



8-Pin Hermetic DIP (Z Suffix)
Epoxy Mini-DIP (P Suffix)
8-Pin SO (S Suffix)



ORDERING GUIDE[1]

Model	V_{OS} max (T_A = +25°C)	Temperature Range	Package Options
REF02AJ[2]	±15 mV	–65°C to +125°C	TO-99
REF02AZ[2]	±15 mV	–65°C to +125°C	8-Pin Cerdip
REF02EJ	±15 mV	0°C to +70°C	TO-99
REF02EZ	±15 mV	0°C to +70°C	8-Pin Cerdip
REF02J[2]	±25 mV	–65°C to +125°C	TO-99
REF02Z[2]	±25 mV	–65°C to +125°C	8-Pin Cerdip
REF02RC/883	±25 mV	–65°C to +125°C	20-Contact LCC
REF02HJ	±25 mV	0°C to +70°C	TO-99
REF02HZ	±25 mV	0°C to +70°C	8-Pin Cerdip
REF02HP	±25 mV	0°C to +70°C	8-Pin Plastic DIP
REF02CJ	±50 mV	0°C to +70°C	TO-99
REF02CZ	±50 mV	0°C to +70°C	8-Pin Cerdip
REF02CP	±50 mV	–40°C to +85°C	8-Pin Plastic DIP
REF02CS[3]	±50 mV	–40°C to +85°C	8-Pin SO
REF02DP	±100 mV	0°C to +70°C	8-Pin Plastic DIP

NOTES
[1]Burn-in is available on commercial and industrial temperature range parts in cerdip, plastic DIP, and TO-can packages.
[2]For devices processed in total compliance to MIL-STD-883, add/883 after part number. Consult factory for 883 data sheet.
[3]For availability and burn-in information on SO and PLCC packages, contact your local sales office.

8

REV. B

+2.5 V Low Power Precision Voltage Reference

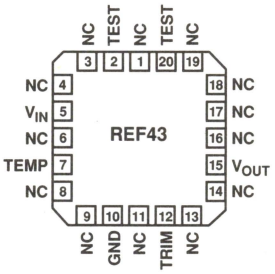
REF43

FEATURES

+2.5 Volt Output: ±0.05% max
Low Temperature Coefficient: 10 ppm/°C max
Excellent Regulation
Load Regulation: 20 ppm/mA max
Line Regulation: 2 ppm/V max
Supply Current: 450 μA max
Temperature Voltage Output: +1.9 mV/°C
Operating Voltage Range: +4.5 V to +40 V
Extended Industrial Temp Range: –40°C to +85°C

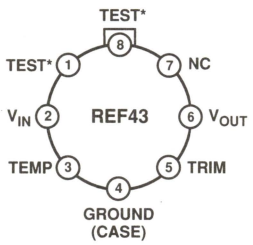
PIN CONNECTIONS

REF43BRC/883
20-Contact LCC
(RC Suffix)



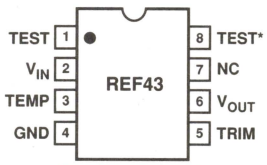
NC = NO CONNECT

TO-99
(J Suffix)



NC = NO CONNECT

8-Pin Cerdip (Z Suffix)
8-Pin Plastic DIP (P Suffix)
8-Pin SO (S Suffix)



NC = NO CONNECT
*RESERVED FOR FACTORY TESTING. MAKE NO ELECTRICAL CONNECTION TO THESE PINS

GENERAL DESCRIPTION

The REF43 is a low power precision reference providing a stable +2.5 V output independent of variations in supply voltage, load conditions or ambient temperature. It is suitable as a reference level for 8-, 10- and 12-bit data acquisition systems, or wherever a stable, known voltage is required.

Tight output tolerances and low thermal drift are assured by Zener-zap trimming of both output voltage and its temperature coefficient. A unique curvature correction circuit reduces the thermal curvature which is characteristic of many previous bandgap references.

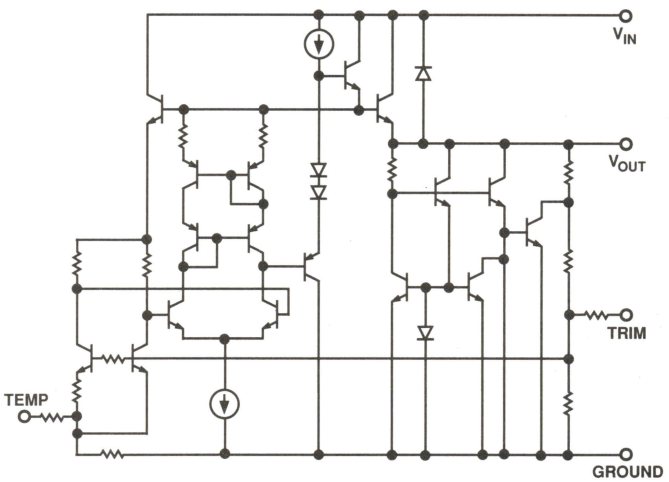


Figure 1. Simplified Schematic

The REF43 may be operated with supply voltages from +4.5 V to +40 V. The output voltage changes by less than 178 μV from one extreme of supply voltage to the other. With only 450 μA maximum quiescent current, the REF43 is ideally suited to applications where power dissipation must be minimized, as in precision battery-powered equipment. The low supply current minimizes drift due to self-heating after power-up.

A temperature output provides a means of determining system ambient temperature. Applications of the REF43 include A/D and D/A conversion, 4-20 mA transmitter/receiver operation, log amplifiers, and power-supply regulators.

For a low cost 2.5 V reference available in small-outline packages consult the REF03 data sheet.

8

REV. C

Precision Micropower, Low Dropout, Voltage References

REF19x Series*

FEATURES
Initial Accuracy: ±2 mV max
Temperature Coefficient: 5 ppm/°C max
Low Supply Current: 45 μA max
Sleep Mode: 15 mA max
Low Dropout Voltage
Load Regulation: 4 ppm/mA
Line Regulation: 4 ppm/V
High Output Current: 30 mA
Short Circuit Protection

APPLICATIONS
Portable Instrumentation
A-to-D and D-to-A Converters
Smart Sensors
Solar Powered Applications
Loop Current Powered Instrumentations

GENERAL DESCRIPTION
REF19x series precision bandgap voltage references use a patented temperature drift curvature correction circuit and laser trimming of highly stable thin film resistors to achieve a very low temperature coefficient and a high initial accuracy.

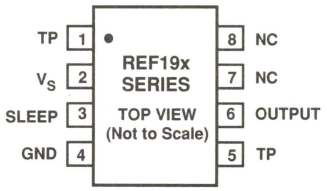
The REF19x series are micropower, Low Dropout Voltage (LDV) devices providing a stable output voltage from supplies as low as 100 mV above the output voltage and consuming less than 45 μA of supply current. In sleep mode, which is enabled by applying a low TTL or CMOS level to the sleep pin, the output is turned off and supply current is further reduced to less than 15 μA.

The REF19x series references are specified over the extended industrial temperature range (–40°C to +85°C) with typical performance specifications over –40°C to +125°C for applications such as automotive.

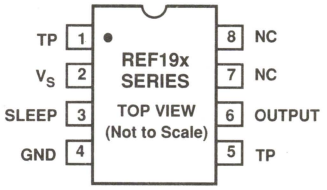
All electrical grades are available in 8-pin SOIC; the PDIP and TSSOP are only available in the lowest electrical grade. Products are also available in die form.

PIN CONFIGURATIONS

8-Lead Narrow-Body SO and TSSOP (S Suffix and RU Suffix)



8-Lead Epoxy DIP (P Suffix)



NC = NO CONNECT
TP PINS ARE FACTORY TEST POINTS
NO USER CONNECTION

Table I

Part Number	Nominal Output Voltage (V)
REF191	2.048
REF192	2.50
REF193	3.00
REF194	4.50
REF195	5.00
REF196	3.30
REF198	4.096

ORDERING GUIDE

Model	Temperature Range	Package Description	Package Option[1]
REF19xGP	–40°C to +85°C	8-Pin Plastic DIP[2]	N-8
REF19xES[3]	–40°C to +85°C	8-Pin SOIC	SO-8
REF19xFS[3]	–40°C to +85°C	8-Pin SOIC	SO-8
REF19xGS	–40°C to +85°C	8-Pin SOIC	SO-8
REF19xGRU	–40°C to +85°C	8-Pin TSSOP	RU-8
REF19xGBC	+25°C	DICE	

NOTES
[1]SO = Small Outline, RU = Thin Shrink Small Outline.
[2]8-pin plastic DIP only available in "G" grade.
[3]REF193 and REF196 are available in "G" grade only.

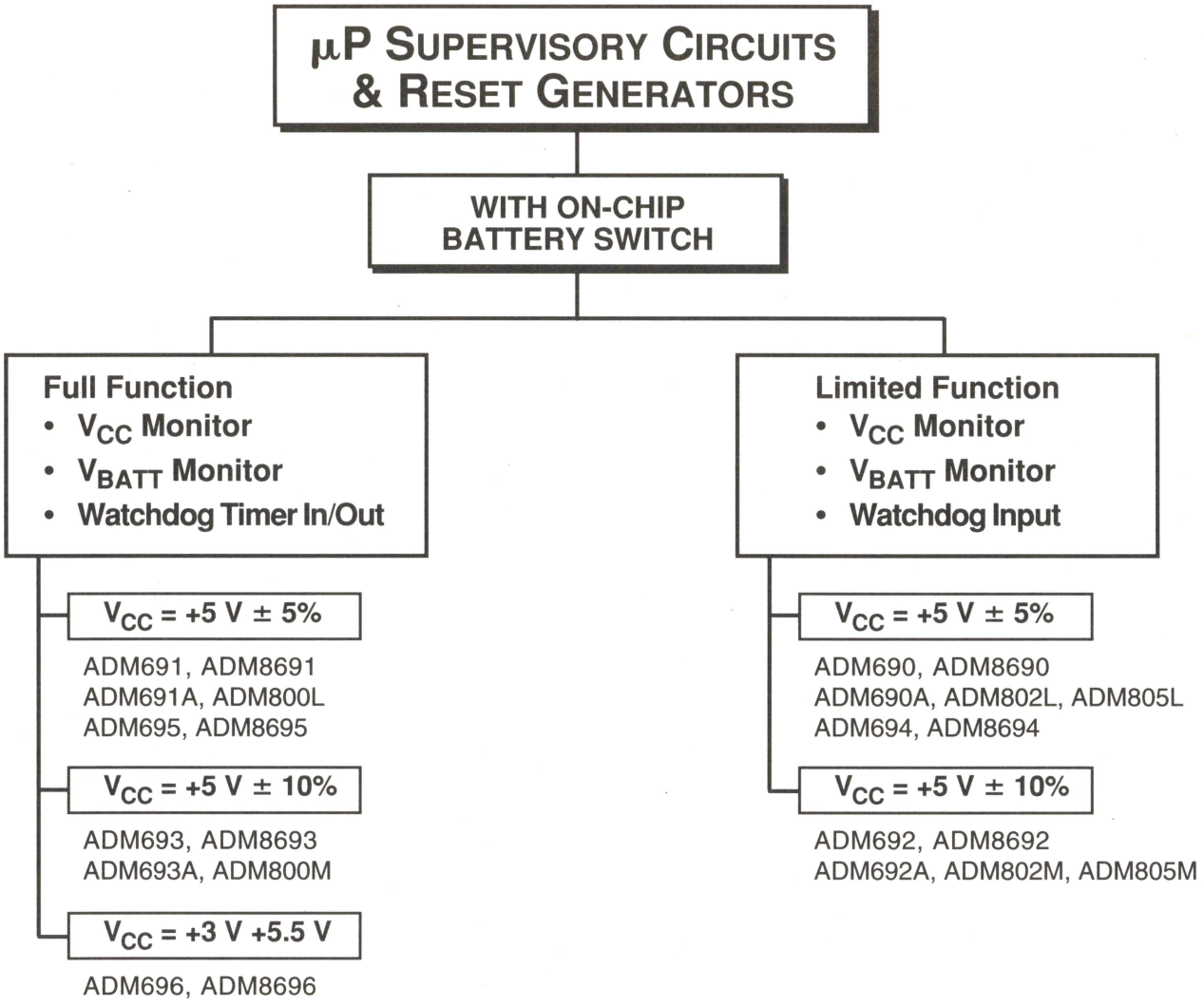
8

REV. C

μPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

With On-Chip Battery Switch

9


µP SUPERVISORY CIRCUITS & RESET GENERATORS
WITH ON-CHIP BATTERY SWITCH
Full Function
• V_{CC} Monitor
• V_{BATT} Monitor
• Watchdog Timer In/Out
V_{CC} = +5 V ± 5%
ADM691, ADM8691
ADM691A, ADM800L
ADM695, ADM8695
V_{CC} = +5 V ± 10%
ADM693, ADM8693
ADM693A, ADM800M
V_{CC} = +3 V +5.5 V
ADM696, ADM8696
Limited Function
• V_{CC} Monitor
• V_{BATT} Monitor
• Watchdog Input
V_{CC} = +5 V ± 5%
ADM690, ADM8690
ADM690A, ADM802L, ADM805L
ADM694, ADM8694
V_{CC} = +5 V ± 10%
ADM692, ADM8692
ADM692A, ADM802M, ADM805M

µPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

With On-Chip V_{BATT} Switch

Model	V_{CC} Range Min	Battery Switch Mode V_{CC} Mode V_{OUT} @ I_{OUT} = 1 mA Min	Battery Switch Mode V_{CC} Mode V_{OUT} @ I_{OUT} = 100 mA Min	V_{BB} Indicator	Reset Generator Threshold Min Volts	Reset Timeout Delay ms Min	Reset Timeout Delay ms Max	# Pins	Lowest Grade Price 100s	Comments	Fax-code
I_{OUT} = 100 mA											
ADM696	+3	V_{CC} to 50 mV	V_{CC} to 500 mV	Yes	+1.25	35	70	16	$3.35	With Low-Line Input	1568
ADM690	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.5	35	70	8	$2.70		1562
ADM691	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.25	35	70	16	$3.00	Full Feature Set	1562
ADM692	+4.5	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.25	35	70	8	$2.70		1562
ADM693	+4.5	V_{CC} to 50 mV	V_{CC} to 500 mV	Yes	+4.5	35	70	16	$3.35	Full Feature Set	1562
ADM694	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.5	140	280	8	$2.80		1562
ADM695	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	Yes	+4.5	140	280	16	$3.35	Full Feature Set	1562
I_{OUT} = 250 mA											
ADM691A	+4.75	V_{CC} to 50 mV	V_{CC} to 300 mV	No	+4.5	140	280	16	$2.00	2nd Generation ADM691	2078
ADM693A	+4.75	V_{CC} to 50 mV	V_{CC} to 300 mV	No	+4.25	140	280	16	$2.20	2nd Generation ADM693	2078
ADM800L	+4.75	V_{CC} to 50 mV	V_{CC} to 300 mV	No	+4.55	140	280	16	$2.20	New Model	2078
ADM800M	+4.75	V_{CC} to 50 mV	V_{CC} to 300 mV	No	+4.30	140	280	16	$2.20	New Model	2078
ADM805L	+4.75	V_{CC} to 20 mV	V_{CC} to 300 mV	No	+4.5	140	280	16	$2.00	New Model	2077
ADM805M	+4.5	V_{CC} to 20 mV	V_{CC} to 300 mV	No	+4.25	140	280	16	$2.00	New Model	2077
ADM690A	+4.75	V_{CC} to 20 mV	V_{CC} to 300 mV	No	+4.5	140	280	16	$2.00	2nd Generation ADM690	2077
ADM692A	+4.5	V_{CC} to 20 mV	V_{CC} to 300 mV	No	+4.25	140	280	16	$2.00	2nd Generation ADM691	2077
ADM802L	+4.75	V_{CC} to 20 mV	V_{CC} to 300 mV	No	+4.55	140	280	16	$2.00	New Model	2077
ADM802M	+4.5	V_{CC} to 20 mV	V_{CC} to 300 mV	No	+4.30	140	280	16	$2.00	New Model	2077
I_{OUT} = 250 mA (3rd Generation)											
ADM8696	+3	V_{CC} to 50 mV	V_{CC} to 500 mV	Yes	+1.25	35	70	16	$3.35	With Low-Line Input	2145
ADM8690	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.5	35	70	8	$2.70		2144
ADM8691	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.25	35	70	16	$3.00	Full Feature Set	2144
ADM8692	+4.5	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.25	35	70	8	$2.70		2144
ADM8693	+4.5	V_{CC} to 50 mV	V_{CC} to 500 mV	Yes	+4.5	35	70	16	$3.35	Full Feature Set	2144
ADM8694	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	No	+4.5	140	280	8	$2.80		2144
ADM8695	+4.75	V_{CC} to 50 mV	V_{CC} to 500 mV	Yes	+4.5	140	280	16	$3.35	Full Feature Set	2144

Microprocessor Supervisory Circuits

ADM690–ADM695

FEATURES

Superior Upgrade for MAX690–MAX695
Specified Over Temperature
Low Power Consumption (5 mW)
Precision Voltage Monitor
Reset Assertion Down to 1 V V_{CC}
Low Switch On-Resistance 1.5 V Normal, 20 V in Backup
High Current Drive (100 mA)
Watchdog Timer—100 ms, 1.6 s, or Adjustable
600 nA Standby Current
Automatic Battery Backup Power Switching
Extremely Fast Gating of Chip Enable Signals (5 ns)
Voltage Monitor for Power Fail

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems

GENERAL DESCRIPTION

The ADM690–ADM695 family of supervisory circuits offers complete single chip solutions for power supply monitoring and battery control functions in microprocessor systems. These functions include µP reset, backup battery switchover, watchdog timer, CMOS RAM write protection, and power failure warning. The complete family provides a variety of configurations to satisfy most microprocessor system requirements.

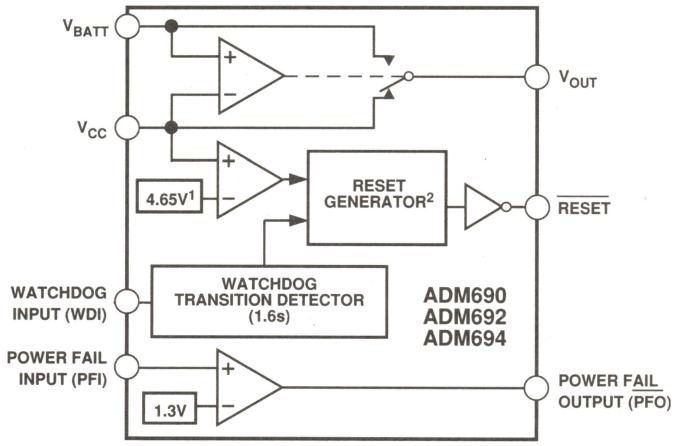
The ADM690, ADM692 and ADM694 are available in 8-pin DIP packages and provide:

1. Power-on reset output during power-up, power-down and brownout conditions. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.
2. Battery backup switching for CMOS RAM, CMOS microprocessor or other low power logic.
3. A reset pulse if the optional watchdog timer has not been toggled within a specified time.
4. A 1.3 V threshold detector for power fail warning, low battery detection, or to monitor a power supply other than +5 V.

The ADM691, ADM693 and ADM695 are available in 16-pin DIP and small outline packages and provide three additional functions.

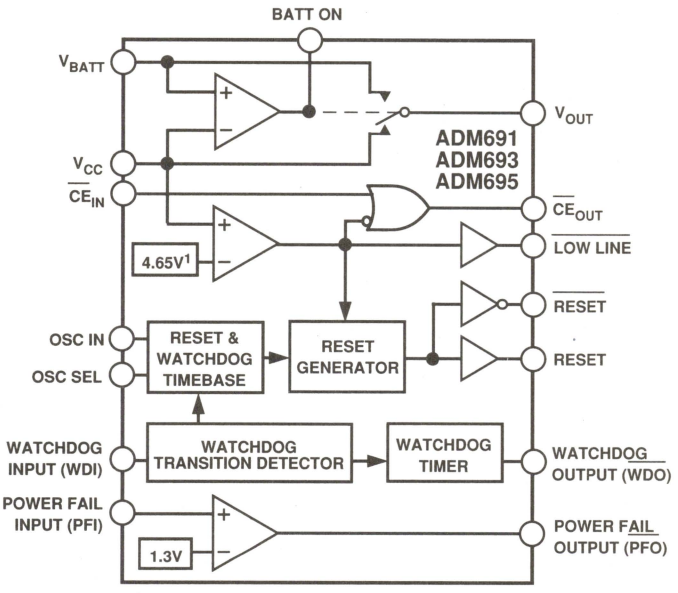
1. Write protection of CMOS RAM or EEPROM.
2. Adjustable reset and watchdog timeout periods.
3. Separate watchdog timeout, backup battery switchover, and low V_{CC} status outputs.

FUNCTIONAL BLOCK DIAGRAMS



[1]VOLTAGE DETECTOR = 4.65V (ADM690, ADM694)
4.40V (ADM692)

[2]RESET PULSE WIDTH = 50ms (ADM690, ADM692)
200ms (ADM694)



[1]VOLTAGE DETECTOR = 4.65V (ADM691, ADM695)
4.40V (ADM693)

The ADM690–ADM695 family is fabricated using an advanced epitaxial CMOS process combining low power consumption (5 mW), extremely fast Chip Enable gating (5 ns) and high reliability. $\overline{\text{RESET}}$ assertion is guaranteed with V_{CC} as low as 1 V. In addition, the power switching circuitry is designed for minimal voltage drop thereby permitting increased output current drive of up to 100 mA without the need for an external pass transistor.

REV. A

ADM696/ADM697

FEATURES

Superior Upgrade for MAX696/MAX697
Specified Over Temperature
Adjustable Low Line Voltage Monitor
Power OK/Reset Time Delay
Reset Assertion Down to 1 V V_{CC}
Watchdog Timer—100 ms, 1.6 s, or Adjustable
Low Switch On Resistance
1.5 Ω Normal, 20 Ω in Backup
600 nA Standby Current
Automatic Battery Backup Switching (ADM696)
Fast On-Board Gating of Chip Enable Signals (ADM697)
Voltage Monitor for Power Fail or Low Battery Warning

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical µP Power Monitoring

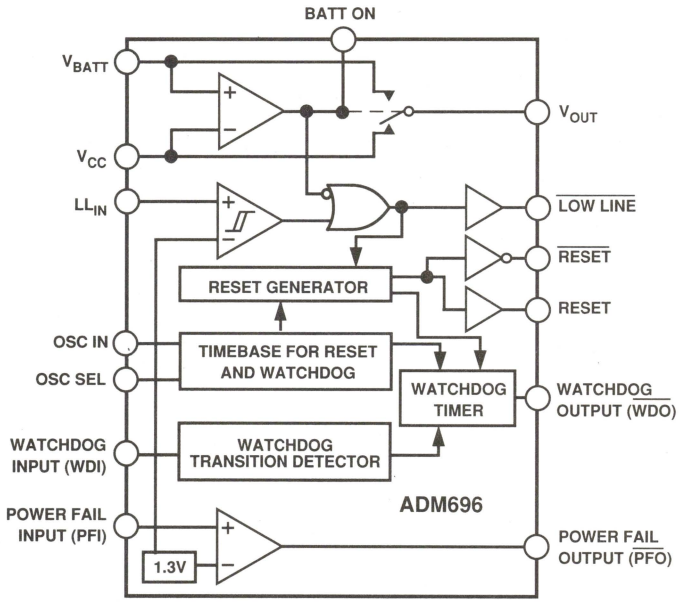
GENERAL DESCRIPTION

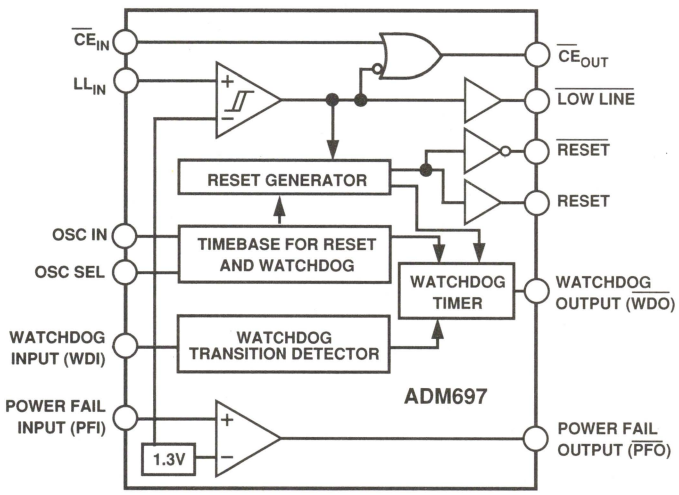
The ADM696/ADM697 supervisory circuits offer complete single chip solutions for power supply monitoring and battery control functions in microprocessor systems. These functions include µP reset, backup-battery switchover, watchdog timer, CMOS RAM write protection, and power failure warning.

The ADM696/ADM697 are available in 16-pin DIP and small outline packages and provide the following functions:

1. Power-On Reset output during power-up, power-down and brownout conditions. The RESET voltage threshold is adjustable using an external voltage divider. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.
2. A Reset pulse if the optional watchdog timer has not been toggled within specified time.
3. Separate watchdog time-out and low line status outputs.
4. Adjustable reset and watchdog timeout periods.
5. A 1.3 V threshold detector for power fail warning, low battery detection, or to monitor a power supply other than V_{CC}.
6. Battery backup switching for CMOS RAM, CMOS microprocessor or other low power logic (ADM696).
7. Write protection of CMOS RAM or EEPROM (ADM697).

FUNCTIONAL BLOCK DIAGRAMS





The ADM696/ADM697 is fabricated using an advanced epitaxial CMOS process combining low power consumption (5 mW), extremely fast Chip Enable gating (5 ns) and high reliability. $\overline{\text{RESET}}$ assertion is guaranteed with V_{CC} as low as 1 V. In addition, the power switching circuitry is designed for minimal voltage drop thereby permitting increased output current drive of up to 100 mA without the need for an external pass transistor.

9

REV. 0

ANALOG DEVICES

Microprocessor Supervisory Circuits

ADM690A/ADM692A/ADM802L/M/ADM805L/M

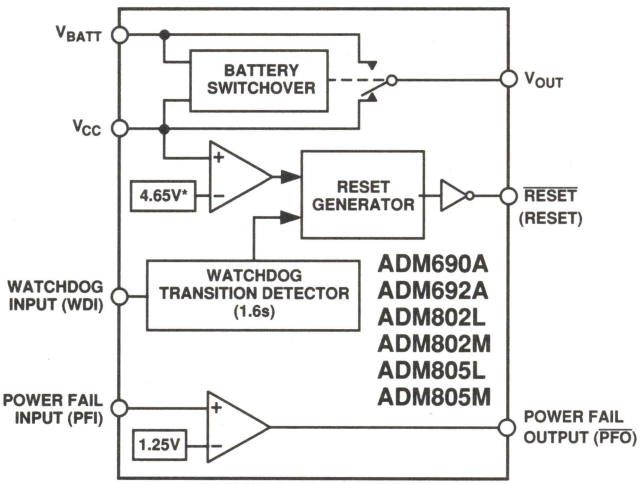
FEATURES

Precision Supply Voltage Monitor
4.65 V ADM690A/ADM802L/ADM805L
4.40 V ADM692A/ADM802M/ADM805M
Reset Assertion Down to 1 V V_{CC}
Reset Timeout—200 ms
Watchdog Timer—1.6 s
100 μA Quiescent Supply Current
Automatic Battery Backup Power Switching
Voltage Monitor for Power Fail
±2% Power Fail Accuracy on ADM802L/M
Space-Saving MicroSOIC Package (ADM690A)

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems

FUNCTIONAL BLOCK DIAGRAM



*4.4V FOR ADM692A/ADM802M/ADM805M
( ) = ADM805L/M ONLY

GENERAL DESCRIPTION

The ADM690A/ADM692A/ADM802L/M/ADM805L/M family of supervisory circuits offers complete single chip solutions for power supply monitoring and battery control functions in microprocessor systems. These functions include μP reset, backup battery switchover, watchdog timer, and power failure warning.

The ADM690A/ADM692A/ADM802L/M/ADM805L/M are available in 8-pin packages and provide:

1. Power-on reset output during power-up, power-down and brownout conditions. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.
2. Battery backup switching for CMOS RAM, CMOS microprocessor or other low power devices.
3. A reset pulse if the optional watchdog timer has not been toggled within 1.6 seconds.
4. A 1.25 V threshold detector for power fail warning, low battery detection, or to monitor a power supply other than +5 V.

On the ADM690A/ADM802L/ADM805L the reset voltage threshold is 4.65 V. On the ADM692A/ADM802M/ADM805M, the reset voltage threshold is 4.40 V.

The ADM802L/ADM802M guarantee power fail accuracies to ±2%.

The ADM805L/M provides an active high reset output, RESET instead of $\overline{\text{RESET}}$.

The family of products is fabricated using an advanced epitaxial CMOS process combining low power consumption and high reliability. $\overline{\text{RESET}}$ assertion is guaranteed with V_{CC} as low as 1 V.

They provide a pin-compatible upgrade for the MAX690A/MAX692A/MAX802L/MAX802M/MAX805L

All parts are available in 8-pin DIP and SOIC packages. The ADM690A is also available in a new space-saving microSOIC package.

REV. 0

ADM691A/ADM693A/ADM800L/M

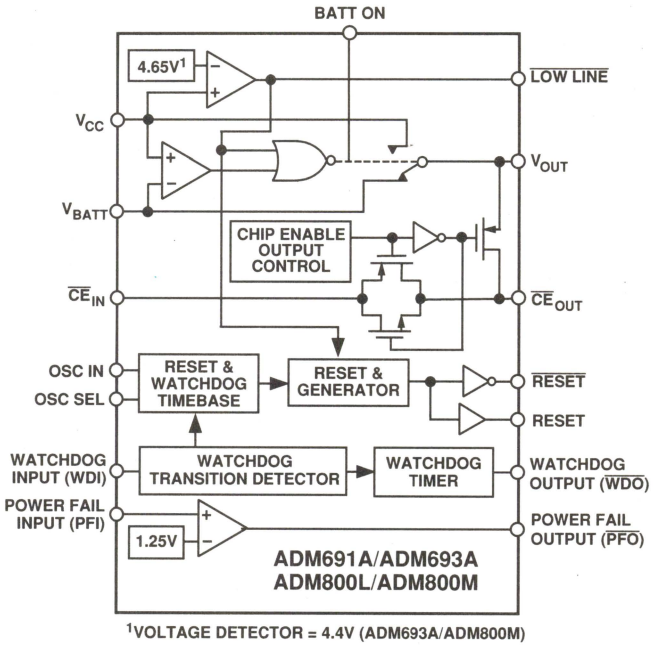
FEATURES

Low Power Consumption:
Precision Voltage Monitor
±2% Tolerance on ADM800L/M
Reset Time Delay—200 ms, or Adjustable
1 μA Standby Current
Automatic Battery Backup Power Switching
Fast Onboard Gating of Chip Enable Signals
Also Available in TSSOP Package (ADM691A)

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical μP Power Monitoring

FUNCTIONAL BLOCK DIAGRAM



[1]VOLTAGE DETECTOR = 4.4V (ADM693A/ADM800M)

GENERAL DESCRIPTION

The ADM691A/ADM693A/ADM800L/ADM800M family of supervisory circuits offers complete single chip solutions for power supply monitoring and battery control functions in microprocessor systems. These functions include μP reset, backup-battery switchover, watchdog timer, CMOS RAM write protection, and power-failure warning. The family of products provides an upgrade for the MAX691A/93A/800M family of products.

All parts are available in 16-pin DIP and SO packages. The ADM691A is also available in a space-saving TSSOP package. The following functionality is provided:

1. Power-on reset output during power-up, power-down and brownout conditions. The circuitry remains operational with V_{CC} as low as 1 V.
2. Battery backup switching for CMOS RAM, CMOS microprocessor or other low power logic.
3. A reset pulse if the optional watchdog timer has not been toggled within a specified time.
4. A 1.25 V threshold detector for power fail warning, low battery detection, or to monitor a power supply other than +5 V.

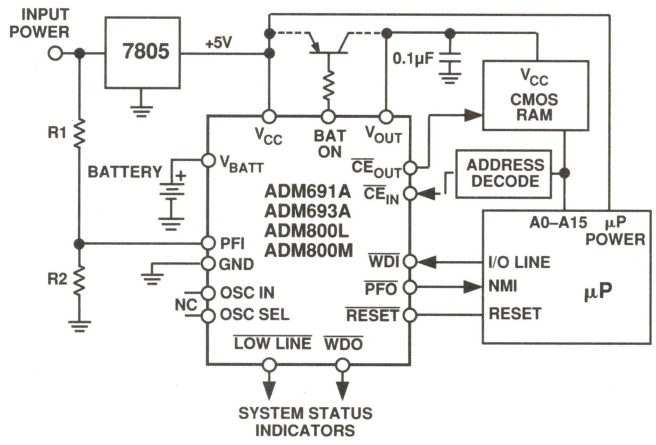


Figure 1. Typical Application

9

REV. 0

ADM8690–ADM8695

FEATURES

Upgrade for ADM690/ADM695, MAX690–MAX695
Specified Over Temperature
Low Power Consumption (0.7 mW)
Precision Voltage Monitor
Reset Assertion Down to 1 V V_{CC}
Low Switch On-Resistance 0.7 Ω Normal, 7 Ω in Backup
High Current Drive (100 mA)
Watchdog Timer—100 ms, 1.6 s, or Adjustable
400 nA Standby Current
Automatic Battery Backup Power Switching
Extremely Fast Gating of Chip Enable Signals (3 ns)
Voltage Monitor for Power Fail
Available in TSSOP Package

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems

GENERAL DESCRIPTION

The ADM8690–ADM8695 family of supervisory circuits offers complete single chip solutions for power supply monitoring and battery control functions in microprocessor systems. These functions include µP reset, backup battery switchover, watchdog timer, CMOS RAM write protection and power failure warning. The complete family provides a variety of configurations to satisfy most microprocessor system requirements.

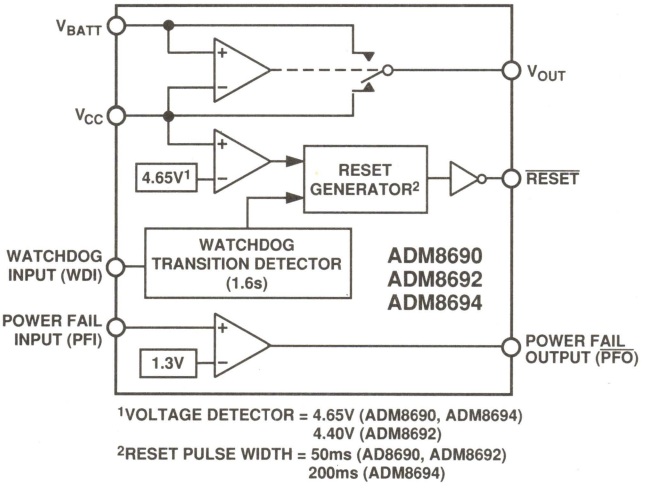
The ADM8690, ADM8692 and ADM8694 are available in 8-pin DIP packages and provide:

1. Power-on reset output during power-up, power-down and brownout conditions. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.
2. Battery backup switching for CMOS RAM, CMOS microprocessor or other low power logic.
3. A reset pulse if the optional watchdog timer has not been toggled within a specified time.
4. A 1.3 V threshold detector for power fail warning, low battery detection or to monitor a power supply other than +5 V.

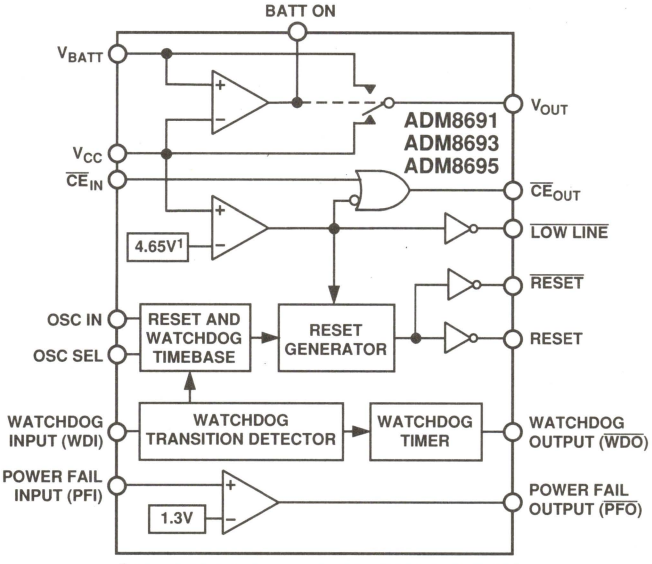
The ADM8691, ADM8693 and ADM8695 are available in 16-pin DIP and small outline packages (including TSSOP) and provide three additional functions:

1. Write protection of CMOS RAM or EEPROM.
2. Adjustable reset and watchdog timeout periods.
3. Separate watchdog timeout, backup battery switchover, and low V_{CC} status outputs.

FUNCTIONAL BLOCK DIAGRAMS



1VOLTAGE DETECTOR = 4.65V (ADM8690, ADM8694)
4.40V (ADM8692)
2RESET PULSE WIDTH = 50ms (AD8690, ADM8692)
200ms (ADM8694)



1VOLTAGE DETECTOR = 4.65V (ADM8691, ADM8695)
4.40V (ADM8693)

The ADM8690–ADM8695 family is fabricated using an advanced epitaxial CMOS process combining low power consumption (0.7 mW), extremely fast Chip Enable gating (3 ns) and high reliability. $\overline{\text{RESET}}$ assertion is guaranteed with V_{CC} as low as 1 V. In addition, the power switching circuitry is designed for minimal voltage drop thereby permitting increased output current drive of up to 100 mA without the need of an external pass transistor.

9

REV. 0

ADM8696/ADM8697

FEATURES

Upgrade for ADM696/ADM697, MAX696/MAX697
Specified Over Temperature
Adjustable Low Line Voltage Monitor
Power OK/Reset Time Delay
Reset Assertion Down to 1 V V_{CC}
Watchdog Timer—100 ms, 1.6 s, or Adjustable
Low Switch On Resistance
0.7 Ω Normal, 7 Ω in Backup
400 nA Standby Current
Automatic Battery Backup Switching (ADM8696)
Fast On-Board Gating of Chip Enable Signals (ADM8697)
Voltage Monitor for Power Fail or Low Battery Warning
Also Available in TSSOP Package

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical μP Power Monitoring

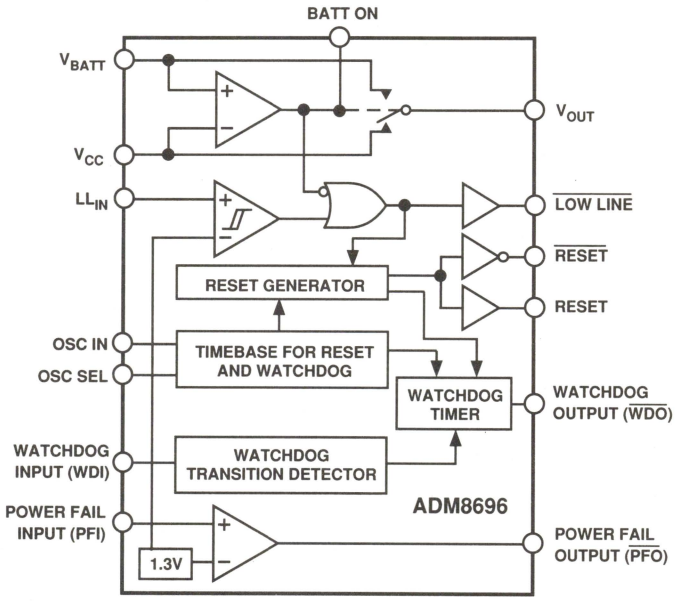
GENERAL DESCRIPTION

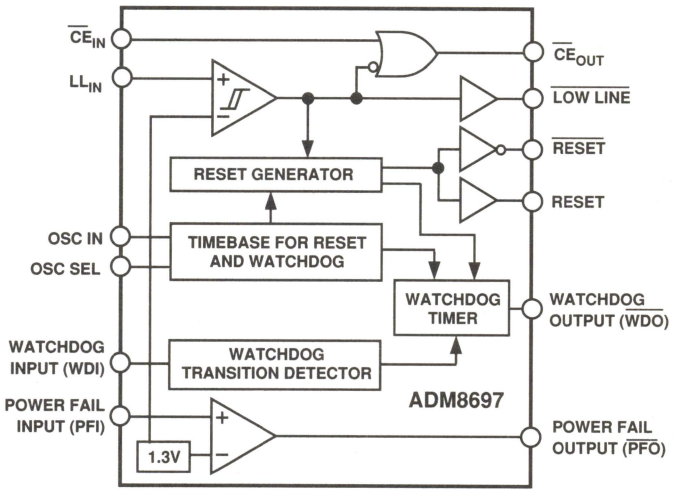
The ADM8696/ADM8697 supervisory circuits offer complete single chip solutions for power supply monitoring and battery control functions in microprocessor systems. These functions include μP reset, backup battery switchover, watchdog timer, CMOS RAM write protection and power failure warning.

The ADM8696/ADM8697 are available in 16-pin DIP and small outline packages (including TSSOP) and provide the following functions:

1. Power-On Reset output during power-up, power-down and brownout conditions. The RESET voltage threshold is adjustable using an external voltage divider. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.
2. A Reset pulse if the optional watchdog timer has not been toggled within specified time.
3. Separate watchdog timeout and low line status outputs.
4. Adjustable reset and watchdog timeout periods.
5. A 1.3 V threshold detector for power fail warning, low battery detection or to monitor a power supply other than V_{CC}.
6. Battery backup switching for CMOS RAM, CMOS microprocessor or other low power logic (ADM8696).
7. Write protection of CMOS RAM or EEPROM (ADM8697).

FUNCTIONAL BLOCK DIAGRAMS





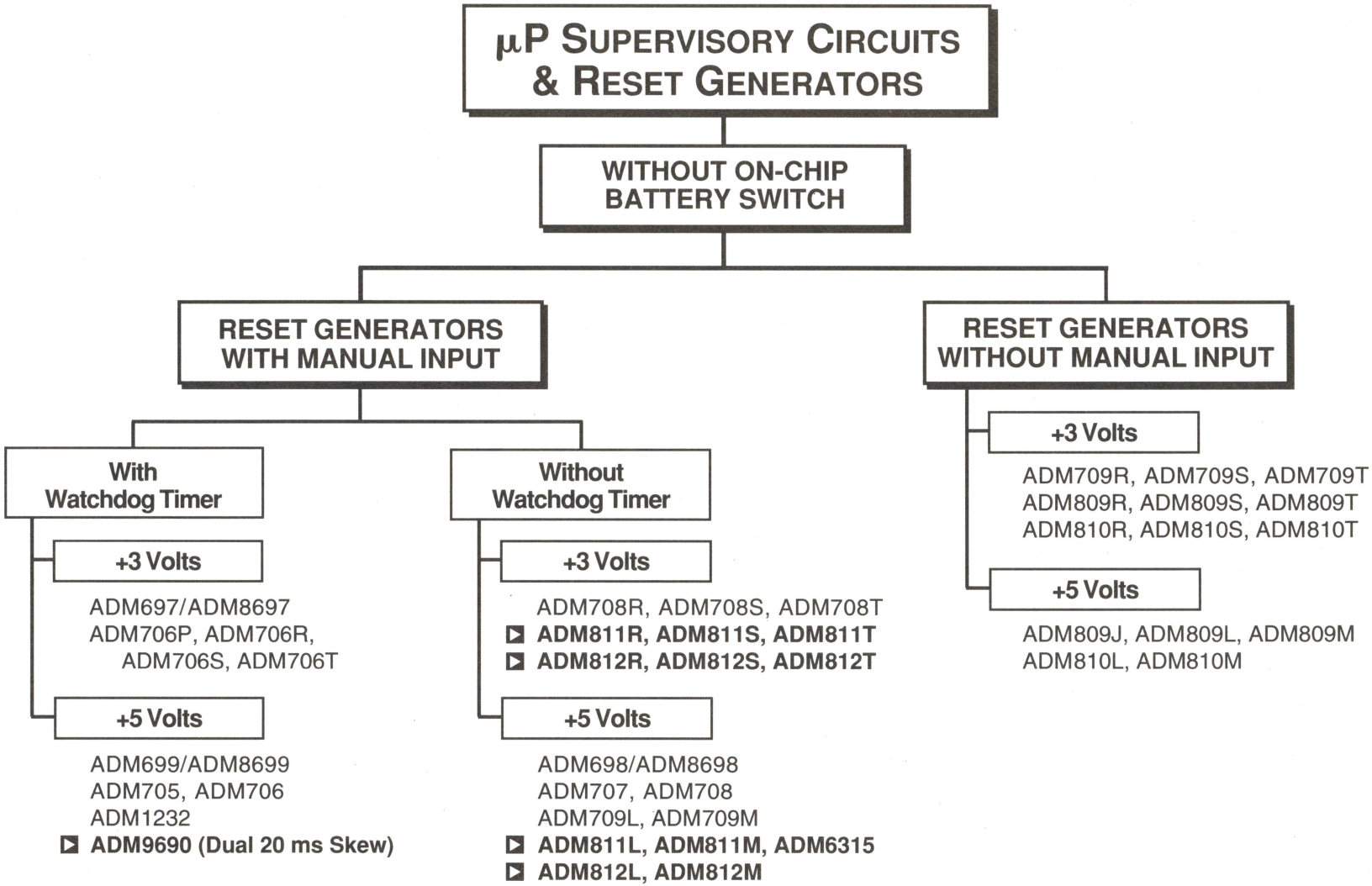
The ADM8696/ADM8697 is fabricated using an advanced epitaxial CMOS process combining low power consumption (0.7 mW), extremely fast Chip Enable gating (2 ns) and high reliability. $\overline{\text{RESET}}$ assertion is guaranteed with V_{CC} as low as 1 V. In addition, the power switching circuitry is designed for minimal voltage drop thereby permitting increased output current drive of up to 100 mA without the need for an external pass transistor.

REV. 0

μPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

Without On-Chip Battery Switch

10



= New Product since *1997 Short Form Designers' Guide.*

µPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

Reset Generators with Manual Input

Model	Reset Generator Threshold Min Volts	Reset Generator Threshold Max Volts	Power Fail Indicator	Power Fail Threshold Min/Max Volts	RESET or $\overline{\text{RESET}}$	Manual Reset	Reset Timeout Delay µs Min	Reset Timeout Delay µs Max	Watchdog Timeout Int. Oscillator Min/Max Long ms	Watchdog Timeout Int. Oscillator Min/Max Short ms	# Pins	Lowest Grade Price 100s	Comments	Fax-code
+3.0 V Circuits with Watchdog Timer														
ADM706P	+2.55	+2.7	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280	1/2.25		8	$2.03		1866
ADM706R	+2.55	+2.7	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280	1/2.25		8	$2.03		1866
ADM706S	+2.85	+3.	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280	1/2.25		8	$2.03		1866
ADM706T	+3.	+3.15	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280	1/2.25		8	$2.03		1866
+5.0 V Circuits with Watchdog Timer														
ADM9690 Voltage Monitor with Dual Reset Outputs Offset by 12.5 ms														
▶ **ADM9690**	**+4.3**	**+5.5**					**35**	**70**	**Pin Prgm 0.75, 1.5, 12.5, 25 µs**			**$TBD**	**Dual Reset Outputs**	**2189**
ADM1232 Reset Levels Pin Programmable														
▶ **ADM1232**	**+4.5**	**+4.74**	**No**	**No**	**R & $\overline{\text{R}}$**	**Yes**	**250**	**1000**	**0.04**	**0.175**	**8**	**$TBD**	**Reset Level = GND**	**2194**
▶ **ADM1232**	**+4.25**	**+4.49**	**No**	**No**	**R & $\overline{\text{R}}$**	**Yes**	**250**	**1000**	**0.04**	**0.175**	**8**	**$TBD**	**Reset Level = V_{CC}**	**2194**
ADM705	+4.5	+4.75	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280	1/2.25		8	$1.21		1865
ADM706	+4.25	+4.5	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280	1/2.25		8	$2.03		1865
+3.0 V Circuits without Watchdog Timer														
ADM708R	+2.55	+2.7	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280			8	$1.05		1866
ADM708S	+2.85	+3.	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280			8	$1.05		1866
ADM708T	+3.	+3.15	Yes	1.2/1.3	$\overline{\text{R}}$	Yes	160	280			8	$1.05		1866
▶ **ADM811S**	**+2.89**	**+2.96**	**No**		$\overline{\text{R}}$	**Yes**					**4**	**$0.70**		**2180**
▶ **ADM811T**	**+3.04**	**+3.11**	**No**		$\overline{\text{R}}$	**Yes**					**4**	**$0.70**		**2180**
▶ **ADM812R**	**+2.59**	**+2.66**	**No**		R	**Yes**					**4**	**$0.70**		**2180**
▶ **ADM812S**	**+2.89**	**+2.96**	**No**		**R**	**Yes**					**4**	**$0.70**		**2180**
▶ **ADM812T**	**+3.04**	**+3.11**	**No**		**R**	**Yes**					**4**	**$0.70**		**2180**
+5.0 V Circuits without Watchdog Timer														
ADM707	+4.5	+4.75	Yes	1.2/1.3	R & $\overline{\text{R}}$	Yes	160	280			8	$1.16		1865
ADM708	+4.25	+4.5	Yes	1.2/1.3	R & $\overline{\text{R}}$	Yes	160	280			8	$1.05		1865
▶ **ADM811L**	**+4.56**	**+4.7**	**No**		$\overline{\text{R}}$	**Yes**	**160**	**280**			**4**	**$1.16**		**2180**
▶ **ADM811M**	**+4.31**	**+4.45**	**No**		$\overline{\text{R}}$	**Yes**	**160**	**280**			**4**	**$1.05**		**2180**
▶ **ADM812L**	**+4.56**	**+4.7**	**No**		**R**	**Yes**	**160**	**280**			**4**	**$1.16**		**2180**
▶ **ADM812M**	**+4.31**	**+4.45**	**No**		**R**	**Yes**	**160**	**280**			**4**	**$1.05**		**2180**
▶ **ADM6315**	**FS**	**FS**	**No**		**R**	**Yes**					**4**	**$0.70**	**Factory Set Thresholds**	**2180**

▶ = New Product since *1997 Short Form Designers' Guide.*

µPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

Reset Generators without Manual Input

Model	Reset Generator Threshold Min Volts	Reset Generator Threshold Max Volts	Power Fail Indicator	Power Fail Threshold Min/Max Volts	RESET or $\overline{\text{RESET}}$	Manual Reset	Reset Timeout Delay µs Min	Reset Timeout Delay µs Max	Watchdog Timeout Int. Oscillator Min/Max Long ms	Watchdog Timeout Int. Oscillator Min/Max Short ms	# Pins	Lowest Grade Price 100s	Comments	Fax-code
+3.0 V Circuits without Watchdog Timer														
ADM709R	+2.55	+2.7	No	No	$\overline{\text{R}}$	No	140	380			8	$0.70		1893
ADM809R	+2.59	+2.66	No	No	$\overline{\text{R}}$	No	140	380			3	$0.70		2159
ADM810R	+2.59	+2.66	No	No	R	No	140	380			3	$0.70		2159
ADM709S	+2.85	+3.	No	No	$\overline{\text{R}}$	No	140	380			8	$0.70		1893
ADM809S	+2.89	+2.96	No	No	$\overline{\text{R}}$	No	140	380			3	$0.70		2159
ADM810S	+2.89	+2.96	No	No	R	No	140	380			3	$0.70		2159
ADM697	+3.	+5.5	NA	No	R & $\overline{\text{R}}$	No	35	70	1/2.25	4032/4097	16	$3.00		1568
ADM8697	+3.	+5.5	NA	No	R & $\overline{\text{R}}$	No	35	70	1/2.25	4032/4097	16	$3.00		2145
ADM709T	+3.	+3.15	No	No	$\overline{\text{R}}$	No	140	380			8	$0.70		1893
ADM809T	+3.04	+3.11	No	No	$\overline{\text{R}}$	No	140	380			3	$0.70		2159
ADM810T	+3.04	+3.11	No	No	R	No	140	380			3	$0.70		2159
+5.0 V Circuits without Watchdog Timer														
ADM809J	+3.93	+4.06	No		$\overline{\text{R}}$	No	160	280			3	$1.05		2159
ADM709M	+4.25	+4.5	No		$\overline{\text{R}}$	No	140	380			8	$0.70		1893
ADM809M	+4.31	+4.45	No		$\overline{\text{R}}$	No	160	280			3	$1.05		2159
ADM810M	+4.31	+4.45	No		R	No	160	280			3	$1.05		2159
ADM698	+4.5	+4.75	No		$\overline{\text{R}}$	No	140	280			8	$1.60		1570
ADM699	+4.5	+4.75	No		R & $\overline{\text{R}}$	No	140	280	1/2.25		8	$1.90		1570
ADM8698	+4.5	+4.75	No		$\overline{\text{R}}$	No	140	280			8	$1.60		2162
ADM8699	+4.5	+4.75	No		R & $\overline{\text{R}}$	No	140	280	1/2.25		8	$1.90		2162
ADM709L	+4.5	+4.75	No		$\overline{\text{R}}$	No	140	380			8	$0.70		1893
ADM809L	+4.56	+4.7	No		$\overline{\text{R}}$	No	160	280			3	$1.16		2159
ADM810L	+4.56	+4.7	No		R	No	160	280			3	$1.16		2159

ADM698–ADM699

FEATURES

Superior Upgrade for MAX698/MAX699
Guaranteed $\overline{\text{RESET}}$ Assertion with V_{CC} = 1 V
Low 0.6 mA Supply Current
Precision 4.65 V Voltage Monitor
Power OK/Reset Time Delay
Watchdog Timer
Minimum Component Count
Performance Specified over Temperature

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical µP Power Monitoring

GENERAL DESCRIPTION

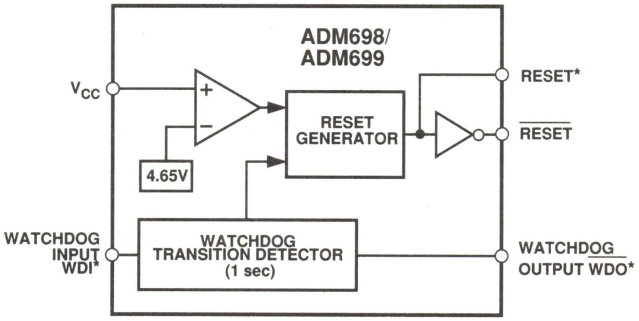
The ADM698/ADM699 supervisory circuits provide power supply monitoring and watchdog timing for microprocessor systems.

The ADM698 monitors the 5 V V_{CC} power supply and generates a $\overline{\text{RESET}}$ pulse during power up, power down and during low voltage "Brown Out" conditions. The $\overline{\text{RESET}}$ output is guaranteed to be functional (logic low) with V_{CC} as low as 1 V.

The ADM699 features an identical monitoring circuit as in the ADM698 plus an additional watchdog timer input to monitor microprocessor activity. The $\overline{\text{RESET}}$ output is forced low if the watchdog input is not toggled within the 1 second watchdog timeout period.

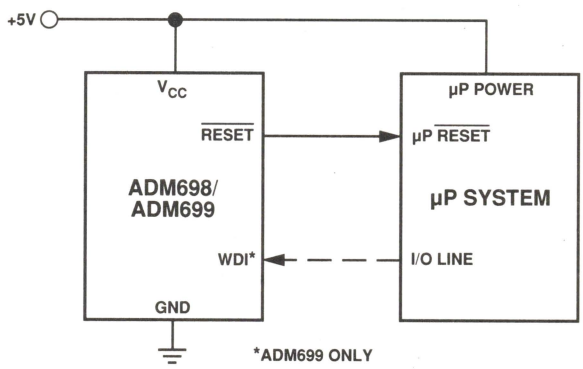
Both parts are available in 8-pin plastic DIP and 16-lead SOIC packages. The 16-lead SOIC contains additional outputs $\overline{\text{RESET}}$ (without inversion) and Watchdog Output $\overline{\text{WDO}}$ (ADM699 only).

FUNCTIONAL BLOCK DIAGRAM



*WDI (ADM699 ONLY)
$\overline{\text{RESET}}$ (SOIC ONLY)
$\overline{\text{WDO}}$ (ADM699 SOIC ONLY)

TYPICAL APPLICATION CIRCUIT



*ADM699 ONLY

10

ADM8698/ADM8699

FEATURES

Superior Upgrade for ADM698/ADM699, MAX698/MAX699
Guaranteed $\overline{\text{RESET}}$ Assertion with V_{CC} = 1 V
Low 70 µA Supply Current
Precision 4.65 V Voltage Monitor
Power OK/Reset Time Delay
Watchdog Timer
Minimum Component Count
Performance Specified over Temperature

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems
Critical µP Power Monitoring

GENERAL DESCRIPTION

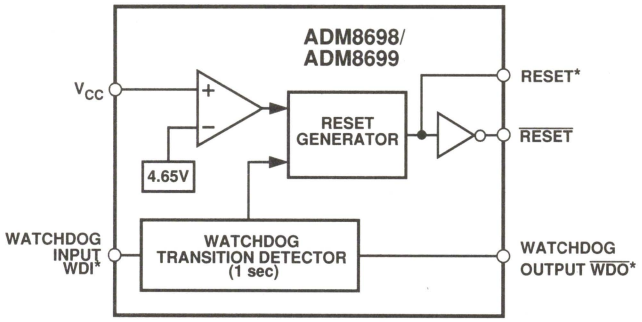
The ADM8698/ADM8699 supervisory circuits provide power supply monitoring and watchdog timing for microprocessor systems.

The ADM8698 monitors the 5 V V_{CC} power supply and generates a $\overline{\text{RESET}}$ pulse during power up, power down and during low voltage "Brown Out" conditions. The $\overline{\text{RESET}}$ output is guaranteed to be functional (logic low) with V_{CC} as low as 1 V.

The ADM8699 features an identical monitoring circuit as in the ADM8698, plus an additional watchdog timer input to monitor microprocessor activity. The $\overline{\text{RESET}}$ output is forced low if the watchdog input is not toggled within the 1 second watchdog timeout period.

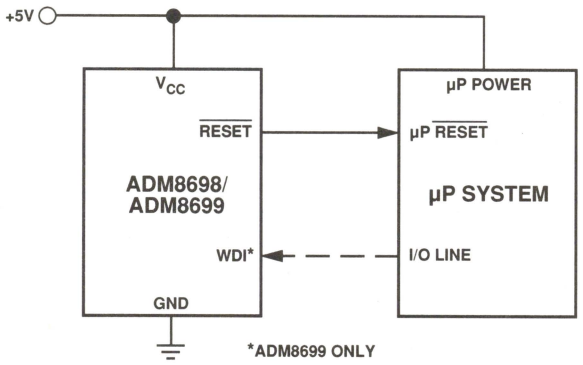
Both parts are available in 8-pin plastic DIP/SOIC and 16-lead SOIC packages. The 16-lead SOIC contains additional outputs $\overline{\text{RESET}}$ (without inversion) and Watchdog Output $\overline{\text{WDO}}$ (ADM8699 only).

FUNCTIONAL BLOCK DIAGRAMS



*WDI (ADM8699 ONLY)
RESET (SOIC ONLY)
$\overline{\text{WDO}}$ (ADM8699 SOIC ONLY)

TYPICAL APPLICATION CIRCUIT



*ADM8699 ONLY

10

ADM705–ADM708

FEATURES

- Guaranteed $\overline{\text{RESET}}$ Valid with V_{CC} = 1 V
- 190 µA Quiescent Current
- Precision Supply-Voltage Monitor
  - +4.65 V (ADM705/ADM707)
  - +4.40 V (ADM706/ADM708)
- 200 ms Reset Pulse Width
- Debounced TTL/CMOS Manual Reset Input ($\overline{\text{MR}}$)
- Independent Watchdog Timer—1.6 sec Timeout (ADM705/ADM706)
- Active High Reset Output (ADM707/ADM708)
- Voltage Monitor for Power-Fail or Low Battery Warning
- Superior Upgrade for MAX705–MAX708
- Also Available in MicroSOIC Packages

APPLICATIONS

- Microprocessor Systems
- Computers
- Controllers
- Intelligent Instruments
- Critical µP Monitoring
- Automotive Systems
- Critical µP Power Monitoring

GENERAL DESCRIPTION

The ADM705–ADM708 are low cost µP supervisory circuits. They are suitable for monitoring the +5 V power supply/battery and can also monitor microprocessor activity.

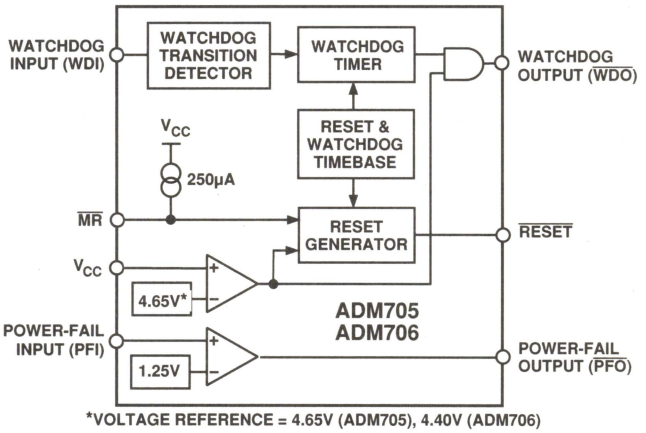
The ADM705/ADM706 provide the following functions:

1. Power-On Reset output during power-up, power-down and brownout conditions. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.
2. Independent watchdog timeout, $\overline{\text{WDO}}$, that goes low if the watchdog input has not been toggled within 1.6 seconds.
3. A 1.25 V threshold detector for power-fail warning, low battery detection or to monitor a power supply other than 5 V.
4. An active low debounced manual reset input ($\overline{\text{MR}}$).

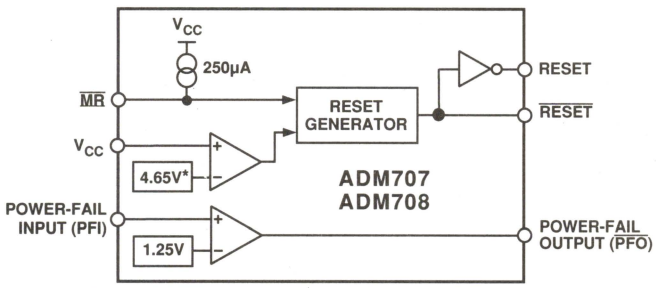
The ADM707/ADM708 differ in that:

1. A watchdog timer function is not available.
2. An active high reset output in addition to the active low output is available.

FUNCTIONAL BLOCK DIAGRAMS



*VOLTAGE REFERENCE = 4.65V (ADM705), 4.40V (ADM706)



*VOLTAGE REFERENCE = 4.65V (ADM707), 4.40V (ADM708)

Two supply-voltage monitor levels are available. The ADM705/ADM707 generate a reset when the supply voltage falls below 4.65 V, while the ADM706/ADM708 require that the supply falls below 4.40 V before a reset is issued.

All parts are available in 8-pin DIP and SOIC packages. The ADM707 and ADM708 are also available in space-saving microSOIC packages.

10

REV. A

+3 V Voltage MONITORING µP Supervisory Circuits

ADM706P/R/S/T, ADM708R/S/T

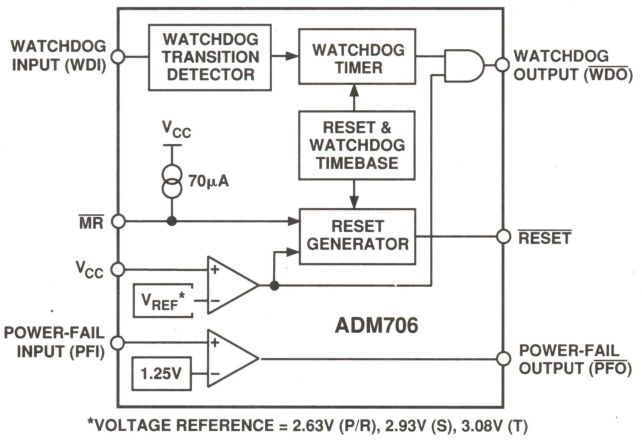
FEATURES

Precision Supply-Voltage Monitor
+2.63 V (ADM706P/R, ADM708R)
+2.93 V (ADM706S, ADM708S)
+3.08 V (ADM706T, ADM708T)
100 µA Quiescent Current
200 ms Reset Pulse Width
Debounced Manual Reset Input ($\overline{MR}$)
Independent Watchdog Timer—1.6 sec Timeout (ADM706x)
Reset Output
Active High (ADM706P)
Active Low (ADM706R/S/T)
Both Active High and Active Low (ADM708R/S/T)
Voltage Monitor for Power-Fail or Low Battery Warning
Guaranteed $\overline{RESET}$ Valid with V_{CC} = 1 V
Superior Upgrade for MAX706P/R/S/T, MAX708R/S/T

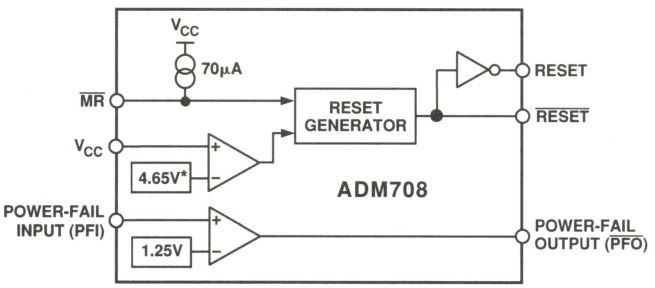
APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Critical µP Monitoring
Automotive Systems
Battery Operated Systems
Portable Instruments

FUNCTIONAL BLOCK DIAGRAMS



*VOLTAGE REFERENCE = 2.63V (P/R), 2.93V (S), 3.08V (T)



*VOLTAGE REFERENCE = 3.63V (R), 2.93V (S), 3.08V (T)

GENERAL DESCRIPTION

The ADM706P/R/S/T and the ADM708R/S/T microprocessor supervisory circuits are suitable for monitoring either 3 V or 3.3 V power supplies.

The ADM706P/R/S/T provide the following functions

1. Power-supply monitoring circuitry which generates a Reset output during power-up, power-down and brownout conditions. The reset output remains operational with V_{CC} as low as 1 V.
2. Independent watchdog monitoring circuitry which is activated if the watchdog input has not been toggled within 1.6 seconds.
3. A 1.25 V threshold detector for power fail warning, low battery detection, or to monitor an additional power supply .
4. An active low debounced manual reset input ($\overline{MR}$).

The ADM706R, ADM706S, ADM706T are identical except for the reset threshold monitor levels which are 2.63 V, 2.93 V, and 3.08 V respectively. The ADM706P is identical to the ADM706R in that the reset threshold is 2.63 V. It differs only in that it has an active high reset output.

The ADM708R/S/T provide the same functionality as the ADM706R/S/T and only differ in that:

1. A watchdog timer function is not available.
2. An active high reset output (RESET) in addition to the active low ($\overline{RESET}$) output is available.

All parts are available in 8-pin DIP and narrow SOIC packages.

10

REV. 0

Microprocessor Supervisory Circuit

ADM1232

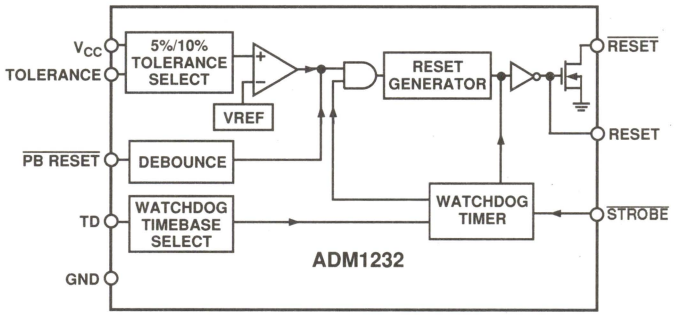
FEATURES

Superior Upgrade for MAX1232 and Dallas DS1232
Low Power Consumption (500 μA max)
Adjustable Precision Voltage Monitor with +4.5 V and +4.75 V Options
Adjustable STROBE Monitor with 150 ms, 600 ms or 1.2 sec Options
No External Components

APPLICATIONS

Microprocessor Systems
Portable Equipment
Computers
Controllers
Intelligent Instruments
Automotive Systems
Protection Against Damage Caused by μP Failure

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADM1232 is a superior, pin-compatible upgrade for the MAX1232 and the DS1232LP and DS1232. The Analog Devices ADM1232 is a microprocessor monitoring circuit that can monitor:

1. Microprocessor Supply Voltage.
2. Whether a Microprocessor has locked-up.
3. An External Interrupt.

The ADM1232 is available in four different packages:

1. The ADM1232ARM in an 8-lead microSOIC (RM-8).
2. The ADM1232AN in an 8-lead PDIP (N-8).
3. The ADM1232ARW in a 16-lead wide SOIC (R-16).
4. The ADM1232ARN is an 8-lead narrow SOIC (R-8).

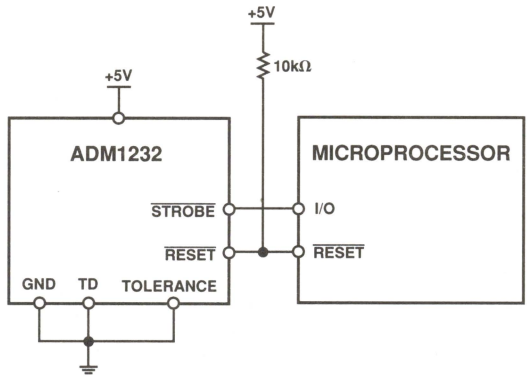


Figure 1. Typical Supply Monitoring Application

10

REV. B

Power Supply Monitor with Reset

ADM709

FEATURES
Precision Supply Voltage Monitor
+5 V, +3.3 V, +3 V Power Supply Monitor
35 μA Quiescent Current
140 ms (min) Power-On Reset Pulse
Low Cost
8-Pin DIP/SO Packages
Upgrade for MAX709

APPLICATIONS
Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Critical μP Monitoring
Automotive Systems
Critical μP Power Monitoring

GENERAL DESCRIPTION

The ADM709 contains a power supply monitor which generates a system reset during power-up, power-down and brownout conditions. When V_{CC} falls below the reset threshold, $\overline{\text{RESET}}$ goes low and holds the μP in reset. On power-up the $\overline{\text{RESET}}$ output is held low for 140 ms after V_{CC} rises above the threshold. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V.

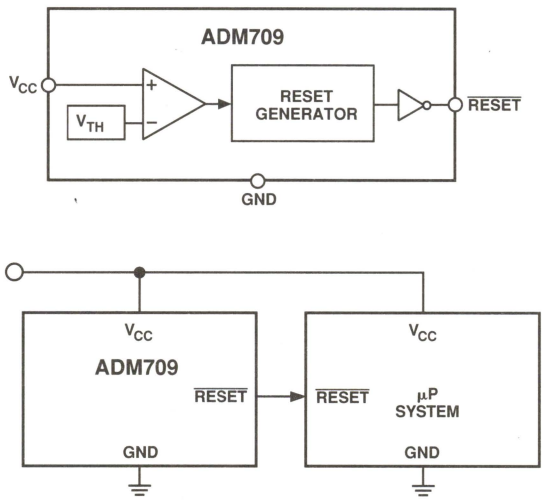
Three supply-voltage threshold levels are available suitable for +5 V, +3.3 V and for +3 V supply monitoring. The actual reset voltage threshold is given below.

The ADM709 is available in 8-pin DIP and SOIC packages.

Table I. Reset Threshold

Suffix	Voltage (V)
L	4.65
M	4.40
T	3.08
S	2.93
R	2.63

FUNCTIONAL BLOCK DIAGRAM



Typical Operating Circuit

ORDERING GUIDE

Model	Reset Threshold	Temperature Range	Package Option*
ADM709LAN	4.65 V	–40°C to +85°C	N-8
ADM709LAR	4.65 V	–40°C to +85°C	SO-8
ADM709MAN	4.40 V	–40°C to +85°C	N-8
ADM709MAR	4.40 V	–40°C to +85°C	SO-8
ADM709TAN	3.08 V	–40°C to +85°C	N-8
ADM709TAR	3.08 V	–40°C to +85°C	SO-8
ADM709SAN	2.93 V	–40°C to +85°C	N-8
ADM709SAR	2.93 V	–40°C to +85°C	SO-8
ADM709RAN	2.63 V	–40°C to +85°C	N-8
ADM709RAR	2.63 V	–40°C to +85°C	SO-8

*N = Plastic DIP; SO = SOIC.

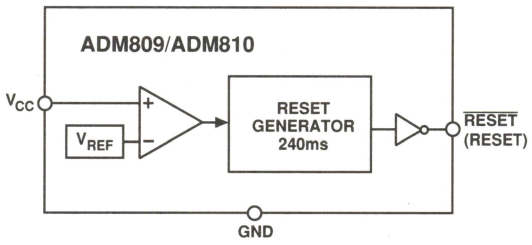
Microprocessor Supervisory Circuit in 3-Pin SOT-23

ADM809/ADM810

FEATURES
Superior Upgrade for MAX809/MAX810
Specified Over Temperature
Low Power Consumption (17 μA)
Precision Voltage Monitor: +3 V, +3.3 V, +5 V Options
Reset Assertion Down to 1 V V_{CC}
140 ms min Power-On Reset
Logic Low $\overline{\text{RESET}}$ Output (ADM809)
Logic High RESET Output (ADM810)

APPLICATIONS
Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADM809/ADM810 supervisory circuits monitor the power supply voltage in microprocessor systems. They provide a reset output during power-up, power-down and brownout conditions. On power-up, an internal timer holds reset asserted for 240 ms. This holds the microprocessor in a reset state until conditions have stabilized. The $\overline{\text{RESET}}$ output remains operational with V_{CC} as low as 1 V. The ADM809 provides an active low reset signal ($\overline{\text{RESET}}$) while the ADM810 provides an active high signal ($\overline{\text{RESET}}$) output.

Six reset threshold voltage options are available suitable for monitoring a variety of supply voltages. Refer to Table I.

The reset comparator features built-in glitch immunity, making it immune to fast transients on V_{CC}.

The ADM809/ADM810 consumes only 17 μA, making it suitable for low power portable equipment. It is packaged in a 3-pin SOT-23 package.

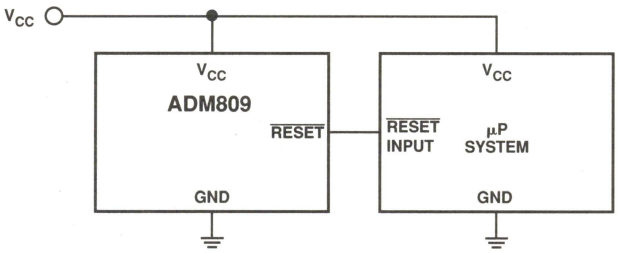


Figure 1. Typical Operating Circuit

10

REV. 0

ADM811/ADM812

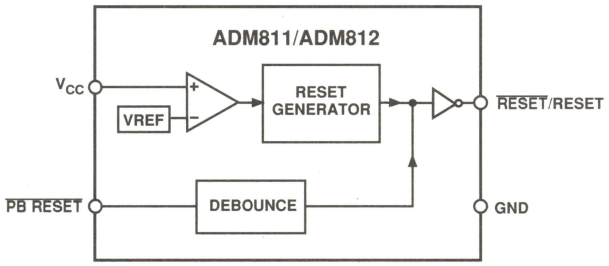
FEATURES

Superior Upgrade for MAX811/MAX812
Specified Over Temperature
Low Power Consumption (6 μA typ)
Precision Voltage Monitor: +3 V, +3.3 V, +5 V Options
Reset Assertion Down to 1 V V_{CC}
140 ms Min Power-On Reset
  Logic Low $\overline{\text{RESET}}$ Output (ADM811)
  Logic High RESET Output (ADM812)
Built-In Manual Reset

APPLICATIONS

Microprocessor Systems
Controllers
Intelligent Instruments
Automotive Systems
Safety Systems
Portable Instruments

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADM811/ADM812 are reliable voltage monitoring devices are suitable for use in most voltage monitoring applications.

The ADM811/ADM812 are designed to monitor five different voltages, each allowing for a 5% or 10% degradation of standard PSU voltages. These voltages have been carefully selected for the effective monitoring of +3 V, +3.3 V and +5 V supply voltage levels.

Included in this circuit is a debounced Manual Reset input. Reset will be activated with an ordinary mechanical switch (or an input from another digital device) or a degradation of the supply voltage. The Manual Reset function is very useful especially if the circuit in which the ADM811/ADM812 is operating enters into a state that can only be detected by the user. Allowing the user to manually reset a system can reduce the damage or danger that could be otherwise be caused by an out-of-control or locked up system.

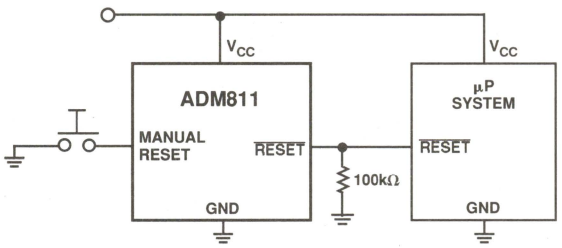


Figure 1. Typical Operating Circuit

10

REV. 0

Microprocessors
Supervisory Circuit in 4-Pin SOT-143

ADM6315

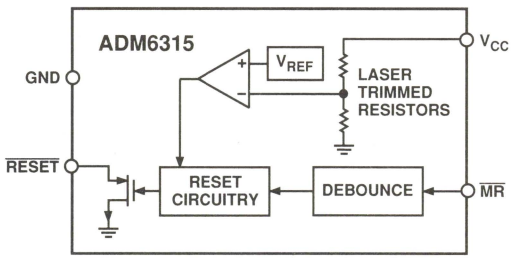
FEATURES

Superior Upgrade for MAX6315
Specified Over Temperature
Low Power Consumption (5 μA typ)
Precision Voltage Monitor of Voltages from 2.5 V to 5 V at 100 mV Increments
Reset Assertion Down to V_{CC} > 1 V
Built-In Manual Reset
Pin Compatable with the ADM811

APPLICATIONS

Microprocessor Systems
Controllers
Intelligent Instruments
Automotive Systems
Safety Systems
Portable Instruments

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADM6315 is a reliable voltage monitoring device suitable for use in most voltage monitoring applications.

The ADM6315 is designed to monitor as little as 1.8% degradation of power supply voltage. Voltages that can be monitored by the ADM6315 are all voltages (at 100 mV increments) from 2.5 V to 5 V.

Included in this circuit is a debounced Manual Reset input. Reset will be activated using an ordinary mechanical switch (by pulling $\overline{MR}$ low), a low input from another digital device or a degradation of the supply voltage. The Manual Reset function is very useful especially if the circuit in which the ADM6315 is operating in, enters into a state that can only be detected by the user. Allowing the user to manually reset a system can reduce the damage or danger that could be otherwise be caused by an out-of-control or locked up system.

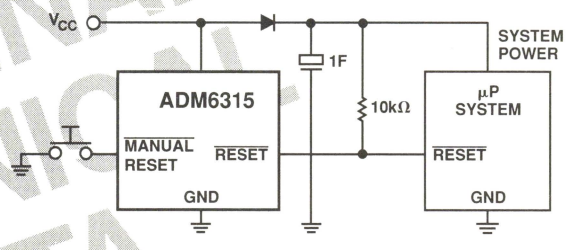


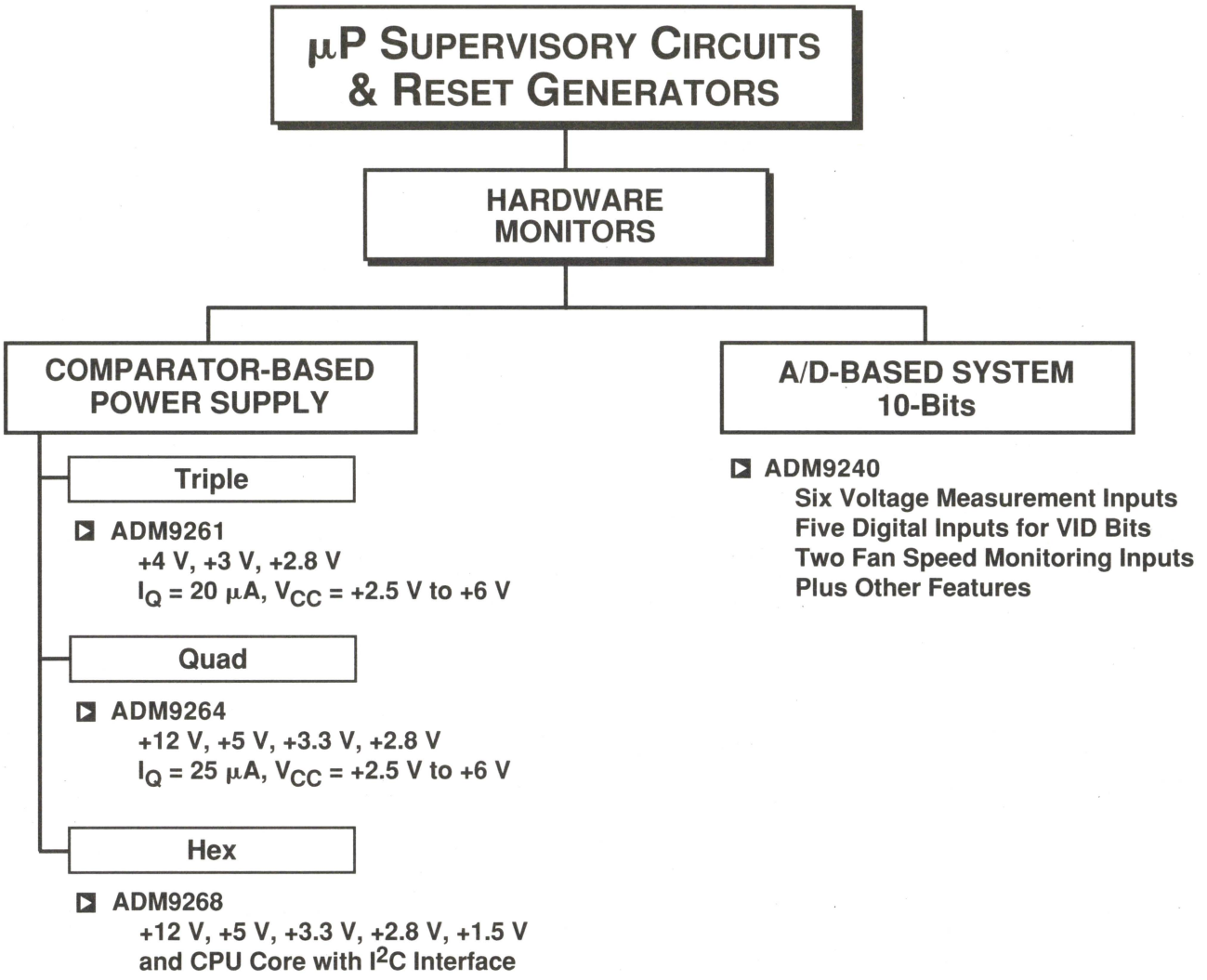
Figure 1. Typical Operating Circuit

10

REV. 0

μPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

Hardware Monitors 11



▶ = New Product since *1997 Short Form Designers' Guide.*

µPROCESSOR SUPERVISORY CIRCUITS & RESET GENERATORS

Hardware Monitors

Model	Reset Threshold Min Volts	Reset Threshold Max Volts	V_{CC} Min Volts	I_{CC} Max µA	R_{IN} kΩ	Hysteresis	Prop Delay µs	# Pins	Lowest Grade Price 100s	Comments	Fax-code
Comparator-Based Power Supply											
Triple											
ADM9261	3.8	4.0	+2.5	20	3000	3%	20	8	TBD	Triple	2207
	2.85	3.0			1650	3%					
	2.66	2.8			1650	3%					
Quad											
ADM9264	12.7	13.2	+2.7	75	200	320 mV	10	16	$1.00	Quad Low Cost	2158
	5.35	5.55			85	130 mV					
	3.53	3.66			55	90 mV					
	2.94	3.05			45	80 mV					
Hex											
ADM9268	12.7	13.2	+2.5	100	240	2%	20	16	TBD	Hex, I^2C Interface	2483
	5.35	5.55			100	2%					
	3.53	3.66			66	2%					
	2.675	2.775	(2.5/3.3 Pin Selectable)		50	2%					
	1.6	1.66			30	2%					
	CPU Core ± 5%				TBD	TBD					

A/D-Based System – 10 Bits

Model	V_{CC} Min Volts	I_{CC} Max mA	I_{CC} S/Down µA	A/D # Bits	Temp Sensor Accuracy %	# Fan Inputs	# Analog Inputs	# Pins	Lowest Grade Price 100s	Comments	Fax-code
ADM9240	+2.85	2	10	10	3	2	6	24	TBD	I^2C I/O	2442

Low Cost Microprocessor System Hardware Monitor

ADM9240

FEATURES

Six Direct Voltage Measurement Inputs (Including Two Processor Core Voltages) with On-Chip Attenuators
On-Chip Temperature Sensor
Five Digital Inputs for VID Bits
LDCM Support
Two Fan Speed Monitoring Inputs
I²C® Compatible System Management Bus (SMBus)
Chassis Intrusion Detect
Interrupt Output
Programmable RESET I/O Pin
Shutdown Mode to Minimize Power Consumption
Limit Comparison of all Monitored Values

APPLICATIONS

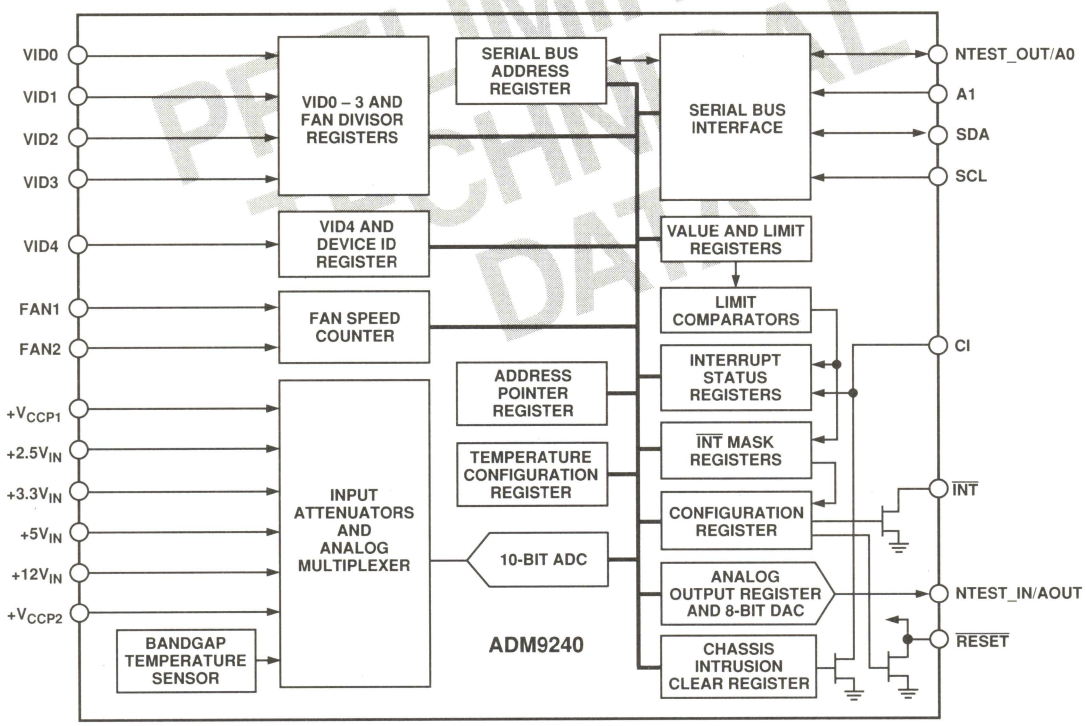
Network Servers and Personal Computers
Microprocessor-Based Office Equipment
Test Equipment and Measuring Instruments

PRODUCT DESCRIPTION

The ADM9240 is a complete system hardware monitor for microprocessor-based systems, providing measurement and limit comparison of up to four power supplies and two processor core voltages, plus temperature, two fan speeds and chassis intrusion. Measured values can be read out via an I²C-compatible serial System Management Bus, and values for limit comparisons can be programmed in over the same serial bus. The high speed successive approximation ADC allows frequent sampling of all analog channels to ensure a fast interrupt response to any out-of-limit measurement.

The ADM9240's 2.85 V to 5.75 V supply voltage range, low supply current and I²C compatible interface, make it ideal for a wide range of applications. These include hardware monitoring and protection applications in personal computers, electronic test equipment and office electronics.

FUNCTIONAL BLOCK DIAGRAM



I²C is a registered trademark of Philips Corporation.

REV. 0

Triple-Power Supply Monitor

ADM9261

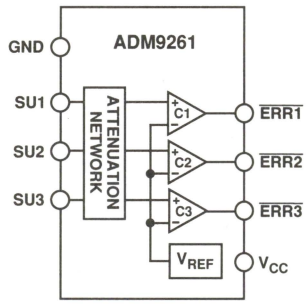
FEATURES

Simultaneous Monitoring of 9 V and Two 3.3 V Supplies
Low Power: 10 μA Typical
Internal Comparator Hysteresis
Power Supply Glitch Immunity
V_{CC} from 2.5 V to 3.6 V
Guaranteed from –10°C to +60°C
No External Components
8-Lead microSOIC Package

APPLICATIONS

Pagers
Portable Instruments

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADM9261 is a multisupply monitor IC that simultaneously monitors the three power supply voltages of a pager system and outputs error signals if any of the supply voltages fall below an acceptable minimum value. Analog Devices' experience in the design of power supply supervisory circuits is used to provide an optimum solution for the overall circuit in terms of cost, performance and power consumption. Key features of the design include the incorporation of hysteresis and glitch immunity into the comparators, which minimizes the possibility of spurious triggering by noise spikes on the supplies being monitored.

Power supply voltages outside V_{CC} can be monitored without the need for input attenuators or other components, and the current drain (including input currents of the monitoring circuits) is typically only 10 μA, which imposes very little additional burden on the pager's battery.

The ADM9261 is manufactured on one of Analog Devices' proprietary BiCMOS processes, which also includes high performance thin-film resistors to achieve the accuracy required for the precision voltage reference and comparator trip points.

The ADM9261 is packaged in a space-saving microSOIC package.

REV. 0

Quad Power Supply Monitor for Desktop PCs

ADM9264

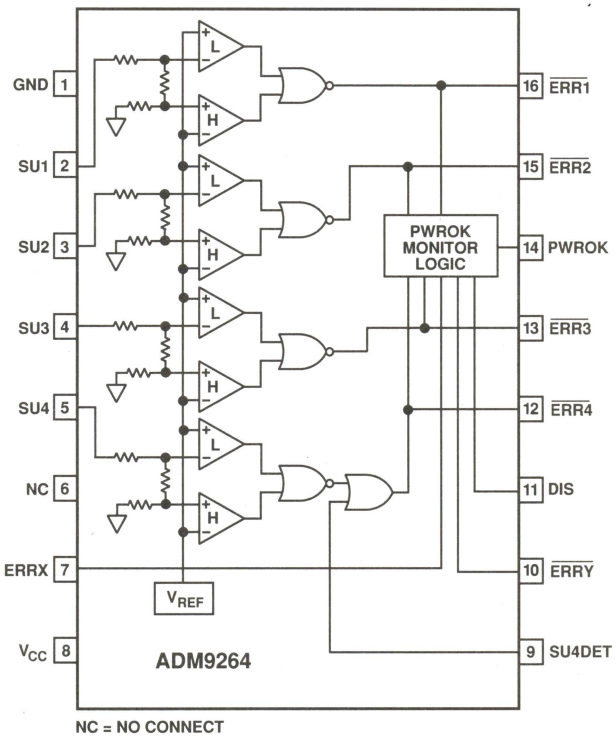
FEATURES

Monitoring of 12 V, 5 V, 3.3 V and 2.8 V Supplies in Parallel
Auxiliary Sensor Inputs
Low Power: 25 μA Typical
Internal Comparator Hysteresis
Power Supply Glitch Immunity
V_{CC} from 2.5 V to 6 V
Guaranteed from –40°C to +85°C
No External Components
16-Pin Narrow SOIC Package (150 Mil Wide)

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Network Systems

FUNCTIONAL BLOCK DIAGRAM



NC = NO CONNECT

GENERAL DESCRIPTION

The ADM9264 is a Quad Supply Monitor IC which simultaneously monitors four separate power supply voltages and outputs error signals if any of the supply voltages go out of limits. It is designed for PC supply monitoring but can be used on any system where multiple power supplies require monitoring. The error output signals are available individually and also gated into a common output - PWROK. Auxiliary inputs ERRX, $\overline{\text{ERRY}}$ are provided which are also gated into the main PWROK signal. These inputs allow signals from other monitoring circuits (for example temperature sensor, alarm, etc.) to be linked into the ADM9264.

Each power supply monitor circuit uses a proprietary window comparator design whereby a three resistor network is used in conjunction with two comparators and a single precision voltage reference to check if the supply is within its required operating tolerance. An added feature of this design is that the power supply voltages being monitored can be higher than the power supply voltage to the monitoring IC itself.

Analog Devices' experience in the design of power supply supervisory circuits is used to provide an optimum solution for the overall circuit in terms of cost, performance and power consumption. Key features of the design include the incorporation of hysteresis and glitch immunity into the comparators, which minimizes the possibility of spurious triggering by noise spikes on the supplies being monitored.

The part is manufactured on one of Analog Devices' proprietary BiCMOS processes, which also includes high performance thin film resistors to achieve the accuracy required for the precision voltage reference and power supply high and low trip points.

REV. 0

Hardware Monitor for Desktop PCs

ADM9268

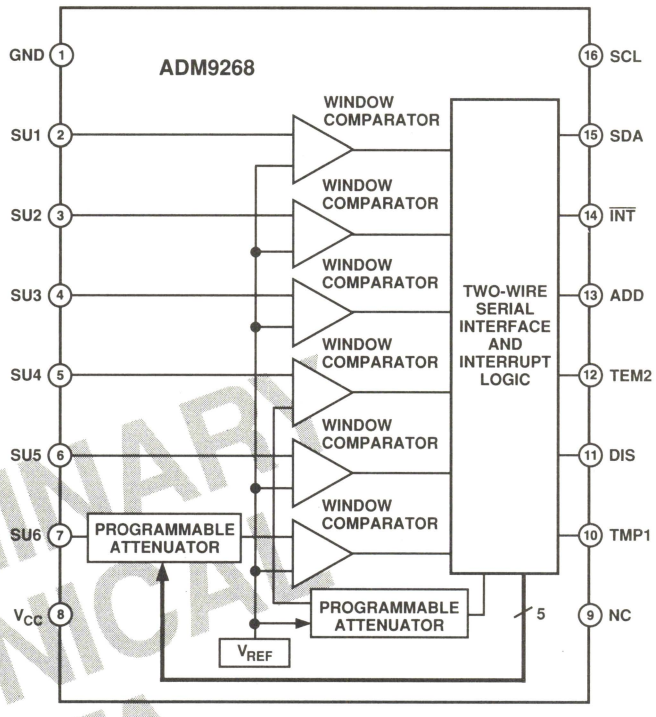
FEATURES

Monitoring of All Desktop PC Supplies in Parallel
Internal Comparator Hysteresis
Power Supply Glitch Immunity
Supports Klamath CPU Core Supply Voltage Options
Two-Wire I^2C Compatible Serial Interface
V_{CC} from 2.5 V to 6 V
Guaranteed Operation from –40°C to +85°C
No External Components
16-Pin Narrow (150 mil) SOIC Package

APPLICATIONS

Microprocessor Systems
Computers
Controllers
Intelligent Instruments
Automotive Systems

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

The ADM9268 Hardware Monitor IC is a self-contained IC which monitors six power supplies in a Desktop PC in parallel and outputs the status information on an Industry Standard two-wire I^2C compatible serial interface. There are also two active low event input pins, TM1 and TMP2, which might come from temperature sensor circuits, which are added to the status information which can be read through the two-wire serial interface.

Each power supply monitor circuit uses a proprietary window comparator design* whereby a three resistor network is used in conjunction with two comparators and a single precision voltage reference to check if the supply is within its required operating tolerance. An added feature of this design is that the power supply voltages being monitored can be higher than the power supply voltage to the ADM9268 IC itself.

The SU6 input is normally used to monitor the CPU Core Voltage. The ADM9268 supports a range of CPU Core Voltage options from 1.3 V to 3.5 V which can be set up by a 5-bit VID code through the serial interface. This makes the ADM9268 compatible with all the CPUs currently available in the marketplace.

Analog Devices' experience in the design of Power Supply Supervisory circuits is used to provide an optimum solution for the overall circuit in terms of cost, performance and power consumption. Key features of the design include the incorporation of hysteresis and glitch immunity into the comparators, which minimizes the possibility of spurious triggering by noise spikes on the supplies being monitored.

The part is manufactured on one of Analog Devices' proprietary BiCMOS processes which also includes high performance thin-film resistors to achieve the accuracy required for the precision voltage reference and power supply high and low trip points.

*Patent Pending

REV. 0

Power Supply and Watchdog Timer Monitoring Circuit

ADM9690

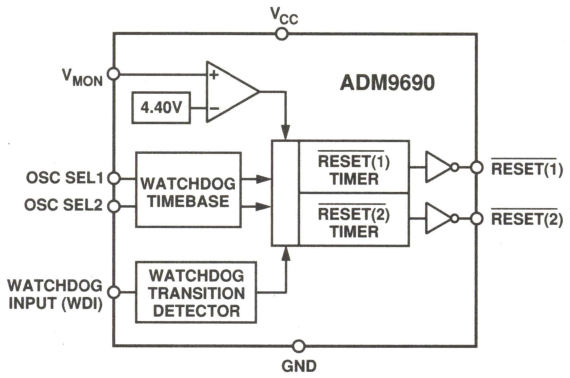
FEATURES

Precision Voltage Monitor (4.40 V)
Watchdog Timeout Monitor
Selectable Watchdog Timeout—0.75 ms, 1.5 ms, 12.5 ms, 25 ms
Two $\overline{\text{RESET}}$ Outputs

APPLICATIONS

Microprocessor Systems
Computers
Printers
Controllers
Intelligent Instruments

FUNCTIONAL BLOCK DIAGRAM



GENERAL DESCRIPTION

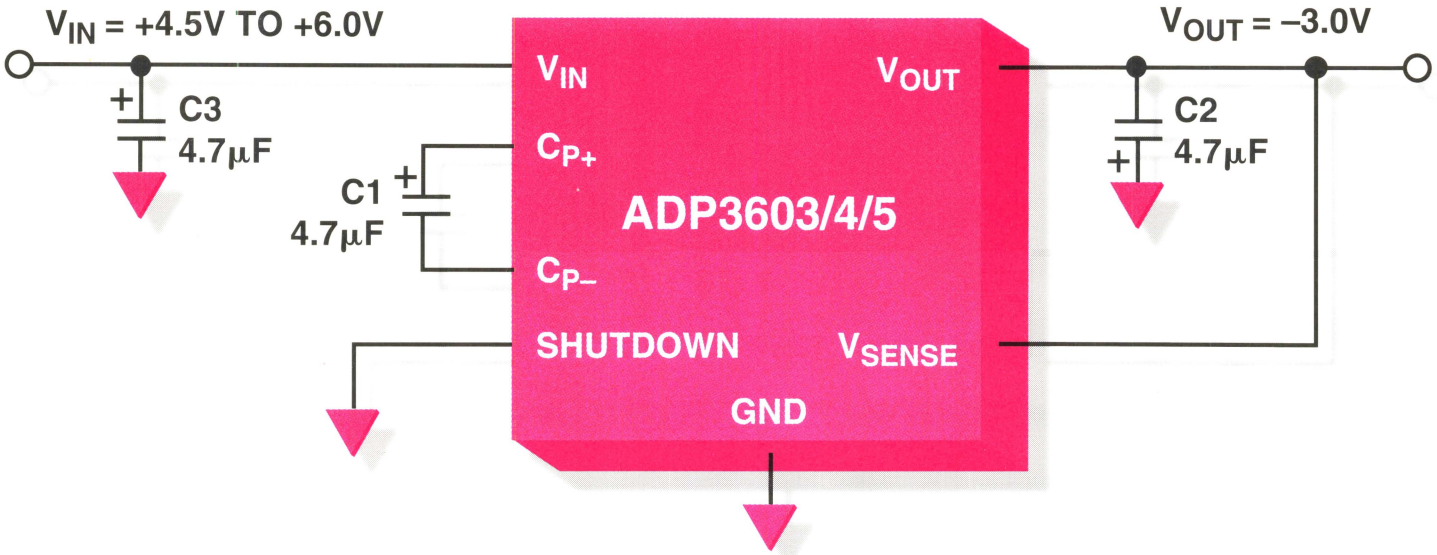
The ADM9690 contains a voltage monitoring comparator and a watchdog timer monitor. It is designed to monitor the 5 V power supply to a microprocessor and the microprocessor operation via a watchdog function.

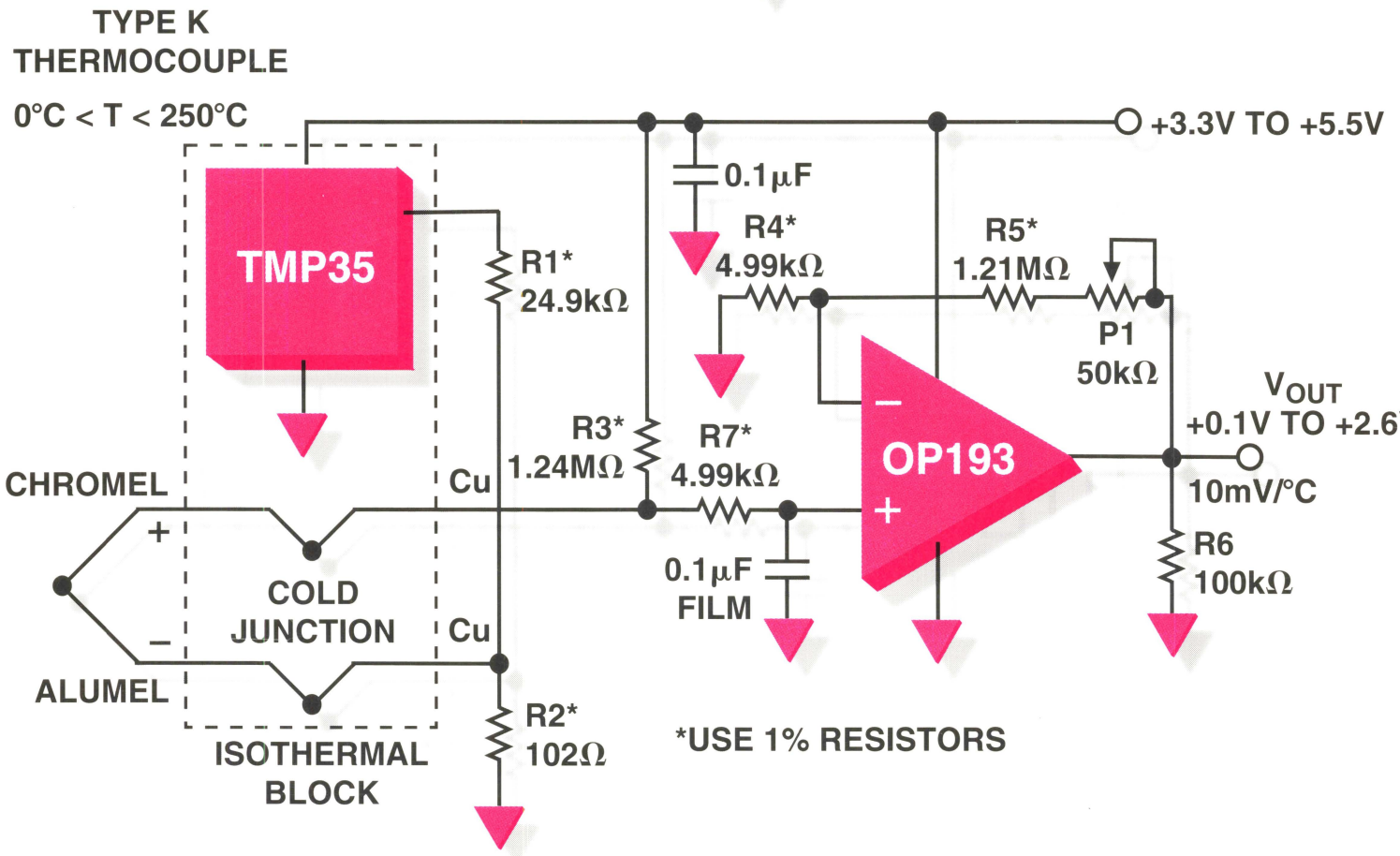
The voltage monitoring comparator monitors the voltage on V_{MON}. If it drops outside tolerance, as will happen during a power-fail, two reset signals are generated. Both reset signals go active (low) simultaneously. They will remain active while V_{MON} is below the threshold, and for 50 ms ($\overline{\text{RESET}}(1)$) or 60 ms ($\overline{\text{RESET}}(2)$) after V_{MON} climbs above the reset threshold. $\overline{\text{RESET}}(1)$ is intended to provide a power-on reset signal for the µP while $\overline{\text{RESET}}(2)$ is used to hold additional circuitry in a reset state until the µP has regained control following a power-up.

The watchdog timer monitoring circuit is designed to monitor the activity on the WDI input. This input is normally connected to an output line on the µP. Its function is to check that the microprocessor has not stalled in an infinite loop. If there is a period of inactivity for the watchdog timeout period, both reset outputs are activated. As above, $\overline{\text{RESET}}(1)$ remains low for 50 ms while $\overline{\text{RESET}}(2)$ remains low for an additional 10 ms. The watchdog timer is restarted when $\overline{\text{RESET}}(1)$ goes inactive. The actual watchdog timeout period is adjustable using two select inputs SEL1 and SEL2.

The ADM9690 is available in an 8-lead SOIC package. It is specified over the industrial temperature range.

REV. 0





ANALOG DEVICES

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